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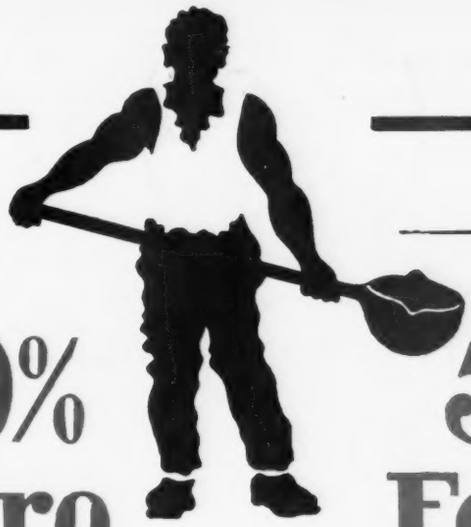

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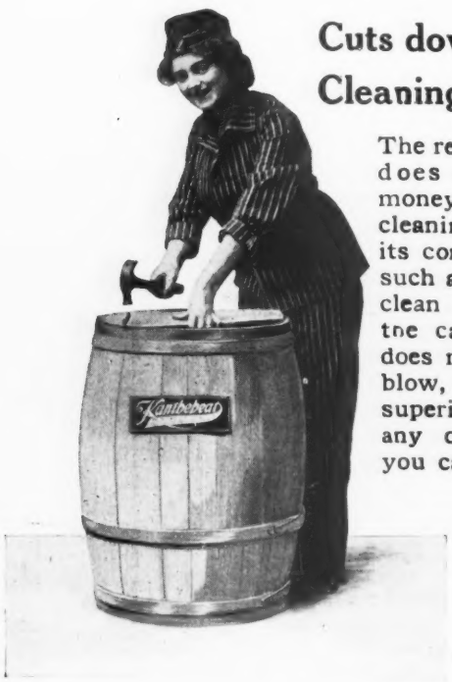

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THE FOUNDRY

Vol. 35, No. 4 CLEVELAND, OHIO, DECEMBER, 1909 Whole No. 208

CRUCIBLE STEEL CASTING PRACTICE

Description of the "Milwaukee" type of melting furnace, used extensively in steel foundries in the west

ALTHOUGH the bulk of the steel casting tonnage of the United States is produced in foundries where the open-hearth or converter is used as the melting medium, nevertheless, the annual output of crucible steel castings shows a steady growth despite the increased cost of manufacture and the limitations in the weight of the sections that can be made in shops where crucible furnaces are used exclusively.

Milwaukee, today, boasts of no less than 10 crucible steel casting plants and is the center of that industry in the west. While the output of each foundry is comparatively small, nevertheless, the aggregate annual production is close to 30,000 tons. The furnaces in use in these shops are similar in design and construction, and may well be termed the "Milwaukee" type, as they are not used extensively elsewhere. Crude oil is used for fuel, and the method of directing the flame against the pots has a tendency to increase their period of usefulness, as high as 10 heats being made in one crucible, although the average varies from seven to eight.

Construction of the Furnaces.

The furnaces are generally 9 feet long, 5 feet wide and from 5 to 6 feet high, being raised above the floor level from 12 to 18 inches. As the furnaces are customarily built in batteries, they are connected by one flue leading to a stack in the center. In front of each furnace, a cleaning pit is provided, and

FIG. 1—METHOD OF REMOVING THE COVER FROM A CRUCIBLE STEEL FURNACE. ALSO SHOWING HOW THE POTS ARE LIFTED OUT

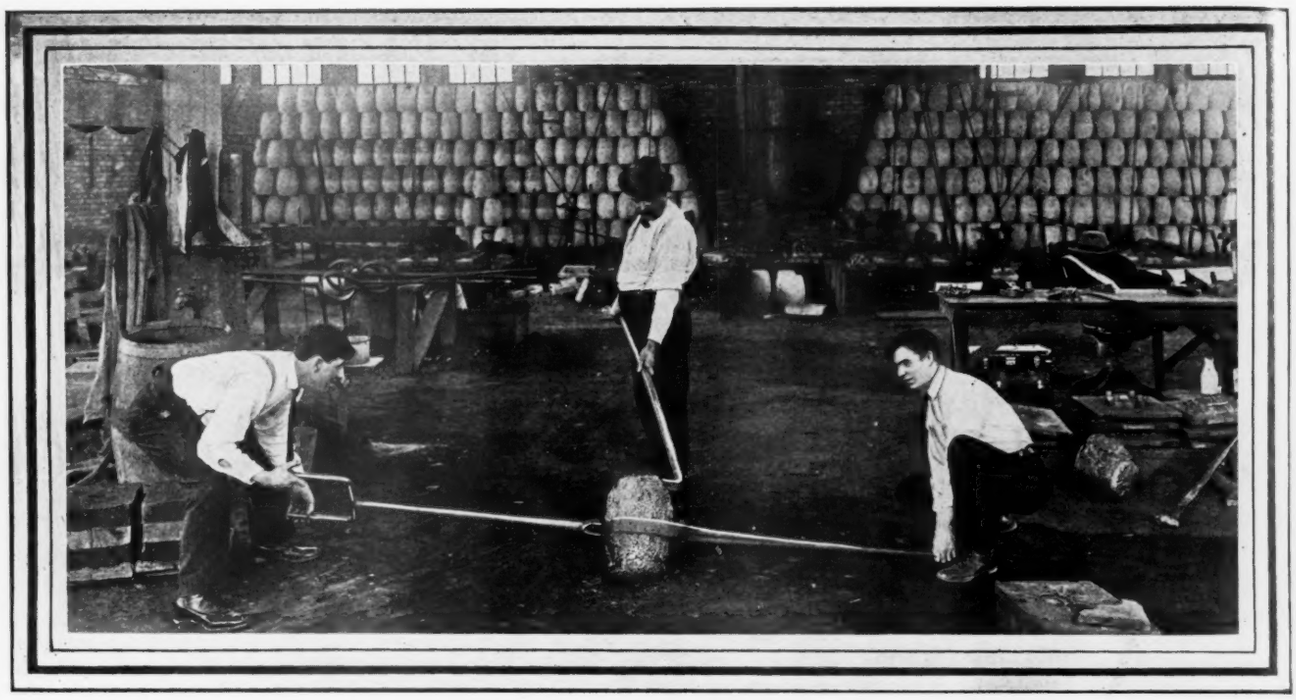


FIG. 2—SKIMMING THE METAL IN THE CRUCIBLE BEFORE POURING THE STEEL INTO THE MOLDS

it is customary to install similar pits on either side, about 2½ feet wide. A battery of seven furnaces, showing this type of construction, installed in the plant of the Prime Steel Co., Milwaukee, is illustrated in Fig. 4. This foundry is one of the most modern in this district, and the practice is typical of that prevailing throughout this great crucible steel casting center.

Each furnace has three chambers for a total of six pots, but only the first chambers are utilized for melting. The middle chamber of each furnace is used for preheating the charges, and the third is used by the melter for inspecting the flame and regulating the furnace. Each chamber holds two crucibles and over each, a cover is placed having two openings, one for each pot, the covers for these openings being made of the bottoms of the worn out crucibles. These are practically the normal thickness when the pots are discarded, as the metal is melted in the tops of the crucibles first, and the flame does not directly contact with the bottoms. At the Prime Steel Co.'s plant, the crude oil is delivered to the furnaces by gravity from four large tanks located in the yard, which have a capacity of two cars of oil. From the supply pipes, shown in front of each furnace in Fig. 4, the oil drops into a series of three pans equipped with overflows, which convey the oil from the upper pan to those underneath. The flame is directed against the two crucibles in the first chamber by natural draft, and is carried over bridge walls into the second and third chambers, in-

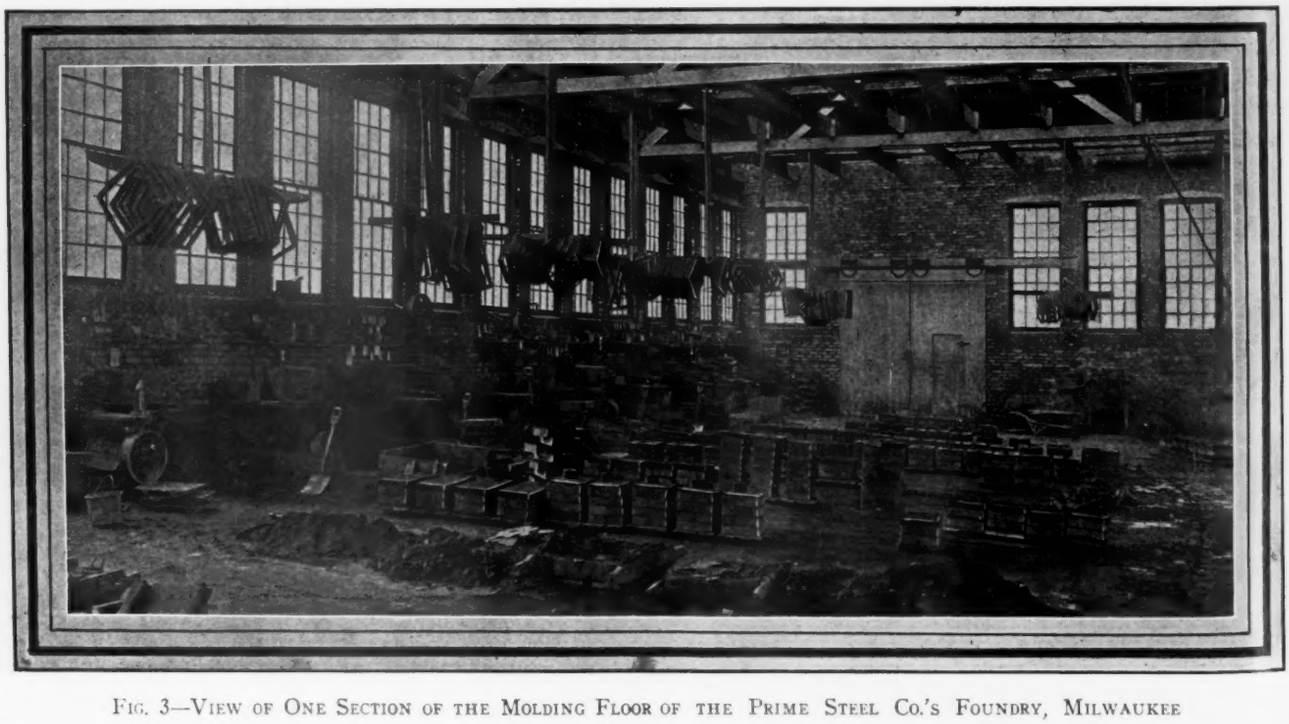


FIG. 3—VIEW OF ONE SECTION OF THE MOLDING FLOOR OF THE PRIME STEEL CO.'S FOUNDRY, MILWAUKEE

to the flue and to the stack. No forced draft being used, the flame has no cutting action on the crucibles, and yet it is of a sufficiently high temperature to melt the steel in from 1 hour and 10 minutes to 1½ hours, the preheating of the charges materially reducing the time required for melting. From six to seven heats can be made daily in each furnace, with an oil consumption of about 170 gallons.

Melting the Metal.

It is customary to light the furnaces early in the morning so that they will be raised to the proper melting temperature when the working force arrives. After the pots in the first or melting chamber have been removed to have their contents poured into the molds, the two crucibles already charged in the second chamber are transferred to the first, and two crucibles containing cold charges are placed in the second, or preheating chamber.

Handling the Crucibles.

To facilitate the removal of the pots from these furnaces, a block and tackle is suspended from a trolley, operating on a rail over each furnace, as shown in Fig. 4. A hook on this block engages a hook on the pulling-out tongs, as shown in Fig. 1, and when lifting out the pots, the tongs are guided by the melter. To facilitate the removal of the cover over the chamber containing the crucibles, a lever is used, as illustrated in Fig.1, which is supported by a chain suspended from a trolley over the furnace. Owing to the intense heat, the melter, who is forced to stand over the melting chamber when lifting out the crucible, wears an asbestos apron and gloves. The flue of the furnaces, extending along the wall, provides excellent storage space for new crucibles, annealing and seasoning them before they are used. The Prime Steel Co. endeavors to constantly carry a stock of two car loads of crucibles, which are shown stacked on the furnace flue in Figs. 1, 2 and 3.

After the pot has been lifted out of the furnace it is carried to the molding floor by tongs having long shanks, and before the metal is cast it is skimmed as shown in Fig. 2. It is also customary to add a small piece of aluminum to each pot of metal, as this has a tendency to prevent blow holes in the castings.

While three to four heats is generally considered a good record for crucibles used in steel melting, nevertheless, in furnaces of this type, the average is from seven to eight, and occasionally, when great care is exercised, a pot can be used for 10 heats. This is undoubtedly due to the less severe usage to which the crucibles are subjected than when coke is used, which has a tendency to reduce the life of the pots, and on the other hand, the mellow flame of the natural draft, crude oil fire, which envelops the crucible, wears it away uniformly with each heat, thus lengthening the life of the pot. A pile of crucibles, in which six and seven heats have been made, is shown in Fig. 5. Although worn away considerably, they can still be used, the charges, of course, being greatly reduced. The new pots have a capacity of approximately 170 pounds of steel.

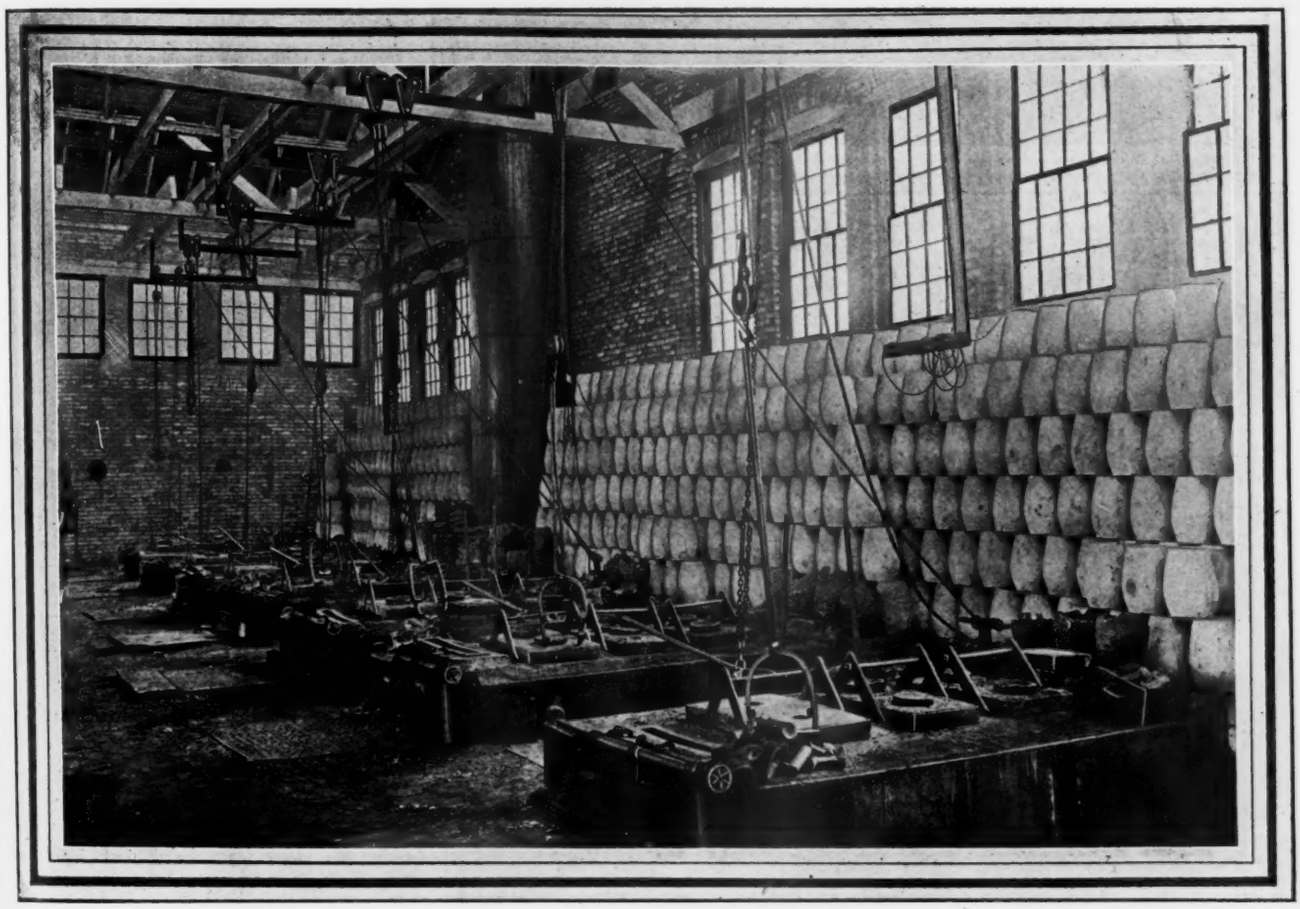


FIG. 4—A BATTERY OF SEVEN, FUEL OIL, CRUCIBLE STEEL MELTING FURNACES IN THE PLANT OF THE PRIME STEEL CO.

Molding Floor.

A view of a section of the molding department of the Prime Steel Co.'s foundry, showing several molding floors, is illustrated in Fig. 3. The main building is 80 x 140 feet, the sand storage, cleaning and core departments being located in attached structures. The bulk of the steel castings produced is annealed in the furnace shown in Fig.

FIG. 5—A PILE OF STEEL CRUCIBLES WHICH AVERAGED SEVEN AND EIGHT HEATS

6, which is heated by crude oil to a temperature of 1,900 degrees Fahr., the castings being permitted to remain in the furnace for annealing from 18 to 24 hours.

Mixture.

In the majority of Milwaukee foundries steel punchings, with from 20 to 30 per cent of returned scrap, constitute the mixture used for ordinary castings. The punchings should be less than 0.04 per cent in phosphorus and 0.04 per cent in sulphur, and it is claimed that the castings made from this material will have a tensile strength of from 55,000 to 65,000 pounds per square inch. While the melting loss is low, the loss including gates, risers, etc., will average 25 per cent on castings of medium size and 35 per cent on very light work. The removable covers over each crucible permit the melter to easily make any special steel desired by dropping the alloy into the pot while the metal is being melted. The average analysis of crucible steel castings follows: Carbon, 0.15 to 0.20 per cent; silicon, 0.08 to 0.20 per cent; manganese, 0.10 to 0.14 per cent; phosphorus, 0.03 to 0.04 per cent; sulphur, 0.03 to 0.04 per cent.

FIG. 6—ANNEALING FURNACE FOR STEEL CASTINGS

A SIMPLE DEVICE FOR MAKING GEARS WITH A SEGMENT PATTERN.

BY P. DWYER

The method employed in making a large, double-shrouded, cycloidal helical gear, described herewith, should prove of interest to foundrymen not using gear molding machines, inasmuch as it more nearly approaches the gear machine in accuracy than any other method with which I am familiar. There are numerous ways of making gears, but unlike an ordinary casting, a gear must be practically perfect, especially the teeth.

Cope Sweep.

As a general rule, a whole pattern for a large gear is out of the question on account of the cost, and in this particular instance, the teeth being helical, the cost of the pattern was actually prohibitive. Furthermore, the gear had to be made as rapidly as possible, and there was no time for a whole pattern. After the plan of procedure was decided upon a cope sweep, *A*, Fig. 2, was made to conform to the upper contour of the casting, projecting beyond the rim about 12 inches to secure a bearing for the cope. This was sent to the foundry, where a hole had already been dug in the floor, which was rammed up level with the floor again after the coke bed had been made. The cross and spindle for the sweep were also set in position, and by the use of the cope sweep, the joint was made. The cope was then rammed, lifted off and finished and placed on supports to be skin-dried, which was not done, however, until the night before the wheel was cast.

Spacing Ring.

In the meantime the remainder of the rigging was being made by the patternmaker, and when the molder had the hole dug again, this time to a size which would give about 9 inches clearance all around to provide room for ramming and rodding the teeth properly, the segments *B* and *C*, Fig. 2, containing the teeth, as well as the spacing ring *S*, and the drag sweep *L*, were sent to the foundry. The spacing and locating ring, *S*, is the distinctive feature of this process, and like nearly

all mechanical appliances, which have given the greatest satisfaction, it is extremely simple. Those who have made gears with the usual segments of two or more teeth, know how extremely slow and annoying is the process of setting the segments so that the last tooth will coincide with the first, after trying the segments all around. I have never known it to come apparently right, except once, and then the molder found, after counting the teeth in the mold, that he only had 67 when he should have had 68. By the use of this spacing ring this guess-work is eliminated, for if the holes in the ring do vary a fraction of an inch, the tooth will only be slightly affected and the error will not be accentuated as the making of the tooth progresses, which is usually the case when a segment pattern is used.

The diameter of the ring makes little difference, and any convenient size will answer the purpose. The ring was made by gluing segments together in the usual manner and was turned in a lathe to finish 5 feet 10 inches outside diameter and 5 feet inside diameter. It had a thickness of 2 inches. A line was scribed on the face of the ring pattern using a radius of 31¼ inches. A similar line was scribed on the layout of the wheel and radial lines drawn to the center of each tooth. The points where these lines intersected were then transferred to the corresponding line of the ring, and by the aid of a wooden jig, 1-inch holes were bored through the ring at these points. The same method was followed when locating the holes of the same size, which were bored through the frame used for the locating holes, Figs. 1 and 2, which were bored through the frames carrying the teeth. Suitable plugs were made to fit these holes. By having these holes in the ring and segments accurately spaced and fitted together with these plugs, it can readily be appreciated that each tooth was definitely located and the chances for error practically eliminated.

Molding the Drag.

When molding the drag, the spacing ring was placed in the bottom of the pit, and it was properly located by the drag sweep *L*, Fig. 2, which was turned around just clearing the ring. Steel spikes were also inserted through the ring into the sand at intervals of 10 inches, as indicated by the points *N*, Fig. 2. This was done to insure absolute rigidity. The bottom of the mold was then rammed, swept off and the sweep *L* was removed. Next, the segment containing the teeth which, as shown in the illustration, was in two parts, was set in the mold, being properly located by the holes and plugs previously referred to. Two teeth were then rammed in the usual way. After this operation was finished the plugs holding the two halves of the segments together were taken out and the top half of the segment was drawn in toward the spindle, a slot of the same size as the diameter of the spindle having been left in one end of the segments for that purpose. The plugs used for locating the lower half of the segment on the spacing ring were next withdrawn and the lower half of the segment pattern was drawn away from the teeth in a similar manner. The segments were then carefully re-set by the holes in the ring for the next teeth, and this operation was repeated until the entire gear mold was finished.

After the mold was completed and tried, the cores were set by the use of the spindle *M*, Fig. 2. This simple contrivance will save considerable time when setting cores on a job similar to this. A ring is made the same size as the outside diameter of the hub, and to this are attached as many blocks as there are arms in the wheel. The spider is dropped into place, locating itself, and the cores will be properly set by keeping them close to the spider when lowering them into the mold. When the arm cores were set, the spider was removed and the center core lowered into place. The cope was then closed over and the mold was finished.

The metal mixture used for this casting consisted of 70 per cent ingot mold scrap having the following analysis: Silicon, 1.40 per cent; sulphur, 0.09 per cent; phosphorus, 0.09 per cent; manganese, 0.30 per cent; 30 per cent of steel scrap was used in the form of billets, 1¾ inches square, and about 20 inches long. Ferro-manganese, 80 per cent, to the amount of 150 pounds was added to each 500-pound charge.

Our cupola is lined to 60 inches, and we used 400 pounds of coke on our bed, and 500 pounds between each charge, which runs uniformly at 5,000 pounds.

We estimate our manganese content in the charge at about 3 per cent, when using from 25 to 40 per cent steel, and the casting will not show more than 1 per cent manganese. The balance unites with the sulphur and other impurities and passes off in the slag. We had our doubts about using such a high percentage of manganese, knowing the hardening effect of this element, but after trying it, the results were most gratifying, and we now make all of our semi-steel after this formula.

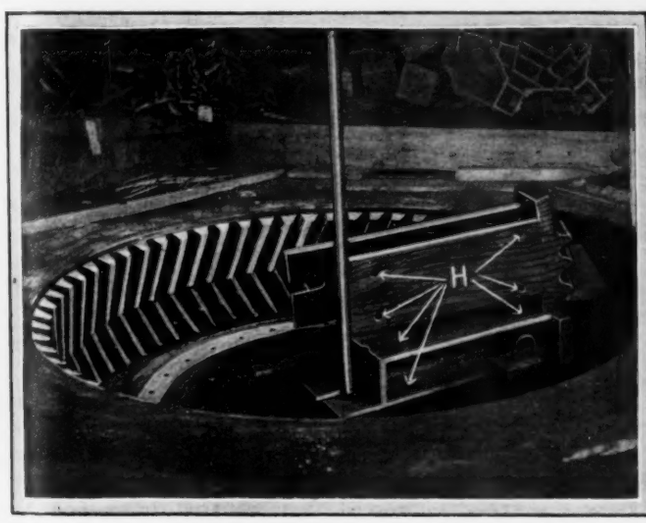


FIG. 1—THE GEAR MOLD PARTLY COMPLETED

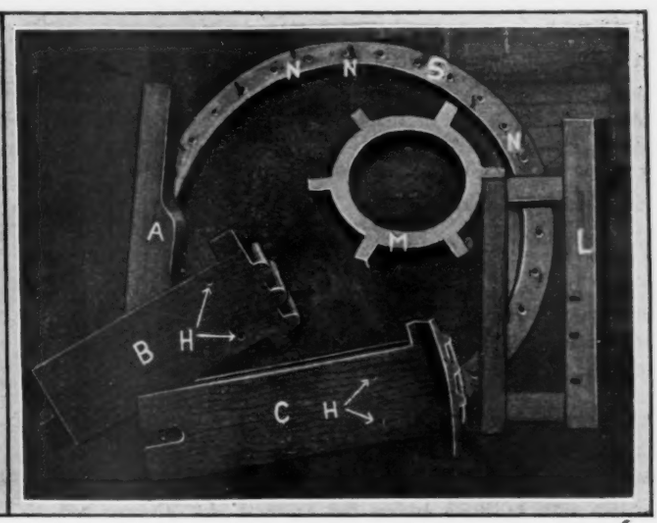
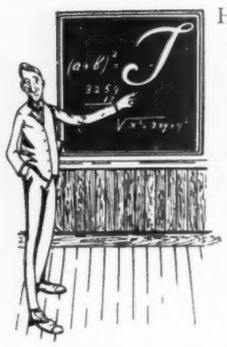


FIG. 2—THE SEGMENT PATTERN, SPACING RING AND SWEEP USED FOR MAKING THE GEAR MOLD

PRACTICAL FOUNDRY MATHEMATICS--II*

Simple formulas for ascertaining the weights of gray iron castings, weight of rammed sand, weight on cope, etc.

BY A. C. HEMIST



THE formulas, herewith presented, have been constructed to solve the problems which only the foundry present. They have been reduced to their simplest form, a single constant being used in each case. We will only consider formulas for finding the weights of various forms of castings in cast iron. In all these formulas the symbols will have the following meaning:

W = weight of casting.
L = length of casting.
T = thickness of casting.
B = width of casting.
A = area.
R = outside radius.
r = inside radius.
D = outside diameter.
d = inside diameter.

All the above dimensions must be in inches and the different formulas are given in the accompanying illustrations.

Example No. 7.

Find the weight of a rectangular casting, 40 inches long, 18 inches in width, and 6 inches in thickness. Using in this case Formula 1, and the symbols as previously shown,

$W = L\ B\ T\ .26$, and substituting,

$W = 40 \times 18 \times 6 \times .26$.

Performing these operations

W = 1123.2 pounds or 1123 pounds.

Example No. 8.

Find the weight of a solid cylinder of cast iron, 20 inches in diameter and 30 inches long. Using Formula 2, $W = D^2\ L\ .204$, and substituting $W = 20^2 \times 30 \times .204$, and performing the operations, W = 2448 pounds.

Example No. 9.

Find the weight of a circular plate, 90 inches in diameter and 4 inches thick. In this case we will use the same formula, No. 2, and consider the thickness as the length of the cylinder, then $W = D^2\ L\ .204$, substituting $W = 90^2 \times 4 \times .204$, therefore W = 6609.6, or practically 6610 pounds.

Example No. 10.

Find the weight of a pipe, 12 inches in diameter, 10 feet long and 2 inches thick. Using in this case Formula 3, $W = (d + T)\ T\ L\ .817$. As this formula is a trifle more complicated we shall explain the same at some length. Our first step will be to reduce all our dimensions to inches. This is a step, which if neglected, will cause considerable trouble. The only dimension to be changed is the length. This being 10 feet equals 120 inches, and we will now proceed to substitute as heretofore, and we have

$W = (12 + 2) \times 2 \times 120 \times .817$.

Now as previously explained the signs of aggregation

( ) [ ] { } ——

show that the quantities within them are to be operated upon previous to performing the other operations indicated by the formula. We therefore proceed to add the 12 and 2 and now we have the following:

$W = 14 \times 2 \times 120 \times .817$.

and proceeding to perform the operations indicated, W = 2745, therefore the weight of such a pipe is 2,745 pounds.

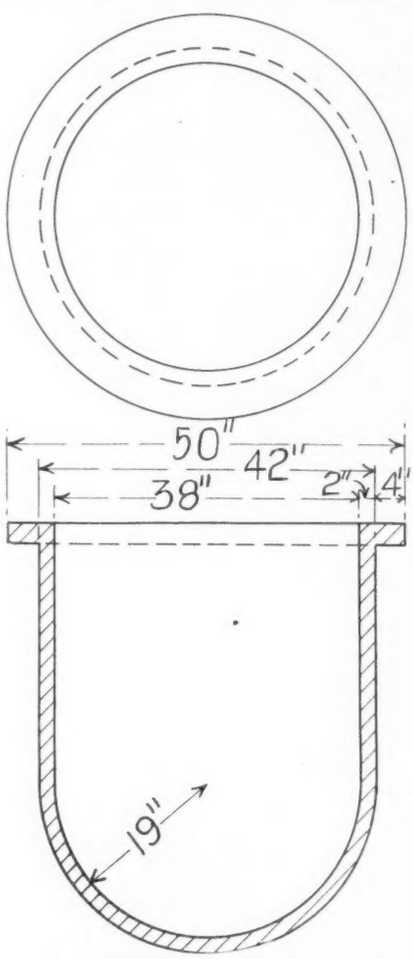


FIG. 1—SPHERICAL BOTTOM KETTLE WITH DIMENSIONS FOR ASCERTAINING THE WEIGHT OF THE CASTING

Example No. 11.

Find the weight of a spherical bottom kettle shown in Fig. 1, 38 inches inside diameter, 2 inches thick, with straight part of sides 30 inches long, and with a flange 4 inches wide and 2 inches thick around the top. In solving this problem, we will be forced to consider the kettle in sections as follows:

First, the bottom.

Second, the sides.

Third, the upper flange.

In solving the problem for the bottom weight, we will use Formula 4, $W = \left(r + \frac{T}{2}\right)^2 T\ 1.652$, although Formula 6 could be used by dividing the result by 2. This formula is a trifle more complicated than the others shown, and also will be explained at length. As all our dimensions are in inches, we are ready to proceed, but we first must find the value of r (inside radius), as this is not given, but as the radius of a circle is ½ of its diameter, then the radius in this case is ½ of 38 or 19. We will now substitute as heretofore, then

$$W = \left(19 + \frac{2}{2}\right)^2 \times 2 \times 1.652.$$

As previously shown, the operation within the brackets must be performed first, and also as previously stated, the division therein indicated must be performed before the addition. We therefore shall proceed and as $2 \div 2 = 1$, we will add this to the 19 as indicated, obtaining 20. If we desired to express our formula as it now would appear, we would have $W = 20^2 \times 2 \times 1.652$, the 20 being subject to the process of squaring as it is the result of the quantities within the brackets, and as previously stated, quantities so enclosed, must be treated only after reducing to a single number. Proceeding one step further, we will square the 20, thus $20 \times 20 = 400$,

*The first article of this series was published in THE FOUNDRY, May, 1909.

and so we obtain W = 400 × 2 × 1.652, and performing the multiplications as indicated W = 1321.6 or practically 1322 pounds, this then being the weight of the bottom section of a kettle of size and shape shown. Proceeding now to a consideration of the straight sides of such a kettle, we will use Formula 3, W = (d + T) T L .817, and substituting W = (38 + 2) 2 × 30 × .817, and reducing to simpler terms, W = 40 × 2 × 30 × .817. Therefore, W = 1960, this being the weight of the straight portion of the foregoing kettle.

Weight of the Flange.

We now proceed to the flange, and considering the width of the flange (4 inches) as the thickness of a hollow cylinder which is 2 inches long, we again use Formula 3, W = (d + T) T L .817. As will be seen, the inside diameter of the flange corresponds to the outside diameter of the kettle and is 42 inches. We will now proceed, and substituting in above formula, W = (42 + 4) 4 × 2 × .817, and performing all the operations we have W = 1095 pounds. The remaining step is the addition of the weights of these different sections, thus 13222 + 1960 + 1095 = 4376 pounds, this then being the weight of a kettle of the sizes given.

Example No. 12.

Find the weight of a solid ball of cast iron, 8 inches in diameter. Using Formula 5, W = D³ .1365. Substituting in the above formula, W = 8³ × .1365, or if we wish to express it more plainly, W = 8 × 8 × 8 × .1365, and therefore W = 69.888 or practically 70 pounds.

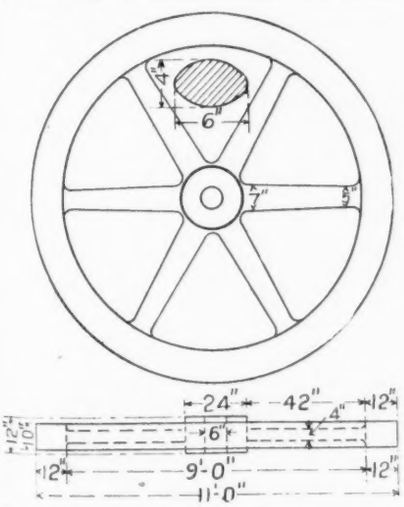


FIG. 2—FLY WHEEL WITH DIMENSIONS FOR ASCERTAINING THE WEIGHT OF THE CASTING

Example No. 13.

Find the weight of a hollow cast iron sphere or ball, 14 inches outside diameter and 2 inches thick. Using Formula 6, W = (D³ — d³) .1365. The inside diameter of the ball in question would be the outside diameter minus the thickness of both walls or 14 — (2 + 2) which equals 10, and substituting we have W = (14³ — 10³) .1365. Reducing the quantities within the brackets we have W = (2,744 — 1,000) .1365, and performing the operations, W = 238.05. A hollow globe or ball of the sizes given will therefore weigh 238 pounds. This problem could also be solved by using Formula 4, and multiplying the result by 2 as follows: Formula 4, $W = \left(r + \frac{T}{2}\right)^2 T\ 1.652$, and as r = ½ of the diameter, then r = 5, and substituting $W = \left(5 + \frac{2}{2}\right)^2 2 \times 1.652$, and performing the operation W = 118.944, and as this is the weight of half of a globe, then 118.944 × 2 = 237.888, or practically 238 pounds.

Example No. 14.

Find the weight of a fly-wheel, as shown in Fig. 2, 11 feet in diameter, with elliptical arms. This casting will also have to be considered in sections, and we shall proceed to divide it, considering first, the hub, second, the rim, and third, the arms. For the hub we will use Formula 3, W = (d + T) T L .817, and substituting the sizes shown in the sketch, we have W = (6″ + 9) × 9 × 12 × .817. Performing these operations we obtain W = 1,323.54, or practically 1,324 pounds. For the rim we use the same formula, considering it a cylinder, 10 inches long and 12 inches thick, and substituting as before, W = (108 + 12) 12 × 10 × .817, and performing these operations we obtain W = 11,764.8 or practically 11,765 pounds. In figuring the weight of the arms of the wheel, we will consider each arm as an ellipse having diameters equal to the average diameters of the arms. Proceeding we will use Formula 7, W = DdL .204. In this formula

D = the large diameter of the ellipse
d = the small diameter of the ellipse
L = the length of the ellipse.

As shown in Fig. 2, the average large diameter of the arms is 6 inches, the average small diameter is 4 inches, and the length is 42 inches. Substituting these values in the above formula, W = 6 × 4 × 42 × 204, and proceeding, W = 205.632, or practically 206 pounds. As this is only the weight of one arm and the sketch shows the wheel to have six such arms, then 6 × 206 = 1,236, this then being the weight of the arms, and the total weight of the wheel will be the sum of these different parts, or 1,324 + 11,765 + 1,236 = 14,325 pounds.

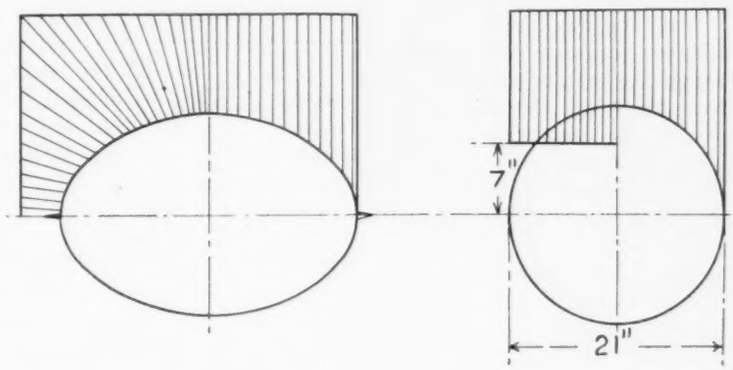


FIG. 3—CROSS-SECTION OF FLYWHEEL ARMS AND SOLID CYLINDER WHICH GRAPHICALLY SHOWS LIFTING PRESSURE ON THE COPE

Example No. 15.

Find the weight of a triangular casting as shown in Formula 8, having the following dimensions:

Length 5 feet, or 60 inches.
Width (at base), 10 inches.
Thickness (or height), 12 inches.

Using in this case Formula 8, W = L B T .13 and substituting, W = 60 × 10 × 12 × .13, therefore W = 936 pounds.

By the use of the foregoing formulas, and the application of a little thought, the weight of any ordinary casting can be computed. Irregular bodies are divided into smaller parts, which will form regular bodies as has been shown. We will therefore content ourselves with the illustration given and pass on to the other problems that present themselves in the foundry.

Example No. 16.

Find the weight of a cope, 6 feet broad, 10 feet long, 9 inches deep, rammed full of sand, ignoring the weight of the cope flask. For this problem we use Formula 9, W =

L B H 87, in which W = weight of sand in pounds, L = length of flask in feet, B = width of flask in feet, and H = height of flask in feet. The first step is to reduce the depth (9 inches) to feet and this equals ¾ foot. Substituting, W = 10 × 6 × ¾ × 87 = 3,915 pounds, thus such a cope will weigh 3,915 pounds.

Weighing the Flask.

We will now consider the problem of computing the weight necessary to place upon a flask for the purpose of holding down the cope during pouring. In the case of a plain plate or casting having a smooth cope surface this problem is very simple, and a formula, No. 10, can be given as follows: W = A H .21 in which

W = the necessary weight.

A = the area of the casting which comes in contact with the cope.

H = the height to the top of the riser above the surface of the casting.

Example No. 17.

How much weight will it require to hold down the cope on a plate, 48 inches wide and 90 inches long, if the top of the risers is 6 inches above the surface of the casting? The first step in this case is to find the area of this plate, and by the formula heretofore given for finding areas, A = L B, and substituting, A = 48 × 90, or 4320. Therefore, the area of the above plate is 4320, and substituting this in Formula 10, W = A H .21, then W = 4320 × 6 × .21 = 5,443.2 pounds, this then being the necessary weight.

In the foregoing, and indeed in all problems of cope securing, the subject is treated as being one of displacement, the sand in the cope displacing the iron which would naturally fill in the cavity if the mold were continued up through the cope. Thus in the case just given we could illustrate by assuming that this plate, 48 inches wide, 90 inches long, would be continued up through the cope thus making a block of iron, 48 inches wide, 90 inches long and 6 inches thick, and we find its weight by using Formula 1, W = L B T .26. Substituting, W = 90 × 28 × 6 × .26, therefore W = 6739, this then being the weight of iron which the sand in the cope on such a plate displaces. However this sand weighs practically 87 pounds to the cubic foot. The amount of this weight can be found by using Formula 9, W = L B H 87, and as these dimensions must be in feet, we have W = 7½ × 4 × ½ × .87 = 1305. As will readily be seen, the difference in these weights will be the amount of weight necessary to overcome the lifting power of the iron, and in this case it equals 6,739 — 1,305 = 5,434 pounds. As will be seen, this compares very closely with the result previously obtained by Formula 10.

However, if we desire to find the exact amount of weight necessary we would have to take into consideration the weight of that portion of the sand in the cope which is beyond the surface of the casting and this would depend entirely on the size of the cope. If a cope of the dimensions given in example 16 is used, we find that such a cope will weigh 3,915 pounds, and as we have shown the lifting force exerted is 6,739 pounds, therefore the weight necessary to be used on the cope would be 6,739 — 3,915 = 2,824 pounds. As will be noted, this is the amount theoretically needed to overcome the hydrostatic pressure of the iron, but there are several other forces which enter into the question which render this unsafe even theoretically, and in practice, a liberal margin should be allowed for safety. It is the opinion of the writer that the weight of the sand, which lies outside the area of the casting can wisely be ignored, and thus we would ordinarily have a fair factor of safety by using Formula 10.

Symbols.

In the formulas on the opposite page —with the exception of Nos. 9, 10 and 11—the symbols have the following meanings:

W = weight of casting, pounds.
L = length, inches.
T = thickness, inches.
B = width, inches.
A = area, inches.
R = outside radius, inches.
r = inside radius, inches.
D = outside diameter, inches.
d = inside diameter, inches.

In Formula No. 9.

W = weight of body of sand, pounds.
L = length of body of sand, feet.
B = width, feet.
H = height, feet.

In Formula No. 10.

W = weight required on cope, pounds.
A = cope area of casting, square inches.
H = height of riser top above casting, inches.

In Formula No. 11.

P = pressure, pounds per square inch.
H = height from point of pressure to riser top, inches.

In these formulas 0.26 is taken as the weight of a cubic inch of cast iron, and all other constants are computed on this basis.

Pressure on Cores in Bottom of Mold.

However, this formula can be conveniently applied, only to castings having flat surfaces, or castings having such surface with lugs in the cope. In the latter case, the surface can be considered as flat. It is in the consideration of irregular castings that this problem becomes difficult. However, if we bear in mind that whenever a body of sand is suspended in a mold, that is, all parts of the mold under which the iron flows, such sand should be considered as displacing a body of iron of equal size, and it therefore will require as much weight to hold this sand down into or upon the iron as the iron so displaced would weigh. The same principle holds good in case of suspended cores, but cores, which rest upon the bottom of the mold, are not subjected to an upward hydrostatic pressure, as there is no iron beneath them. The force which they are subjected to can be considered as the frictional force of the iron which comes in contact with their surfaces. This force can be computed by multiplying the exposed area by the constant .2. This can be illustrated by considering the center core of the fly-wheel previously mentioned. As will be seen this core is 6 inches in diameter and 12 inches long. Its exposed area will therefore be 6 × 3.1416 × 12 = 225 inches, and this multiplied by .2 = 45 pounds, this being the lifting force which is exerted upon this core. This fly-wheel will also serve as a good illustration of the problem of holding down copes.

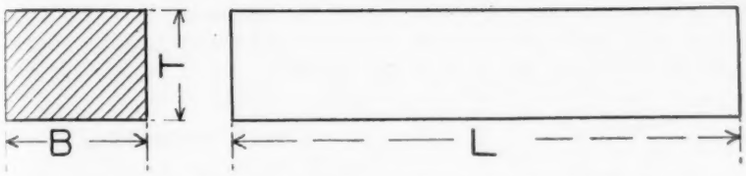
Example No. 18.

Find the weight necessary to hold down a cope 12 feet square and one foot deep, on a fly-wheel shown in Fig. 2, assuming the top of the riser to be the full depth of the cope, or 12 inches. This problem will be solved as it would in practice, the minor details being ignored.

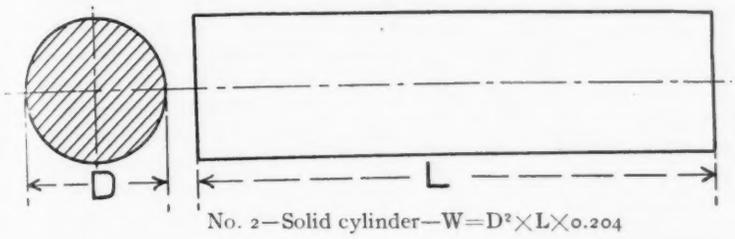
Considering the hub first, we find its cope area by using the formula for circular areas, A = D^2 × .7854. Substituting, A = 24^2 × .7854 = 452 inches. As will be noted, we have ignored the core which in practice it would be admissible to do. The sand over the hub in the cope which is 12 inches deep would therefore displace a body of iron 452 × 12, or 5,424 cubic inches, and this would weigh 5,424 × .26 = 1,410.

As will readily be seen, this result gives us the weight of a casting with the same diameter as the cope area of the hub, 12 inches in length, or as though the hub were extended up through the cope, and we can also see that these results could be obtained much more readily by the use of the formulas for finding the weight of these different bodies, and will therefore proceed to use these formulas. Passing to the rim, we use Formula 3, W = (d + T) T L .817, and substituting, W = (108 + 12) 12 × 12 × .817. Therefore, W = 14,117.76, or 14,118 pounds. The arms, which we will now consider, present a different

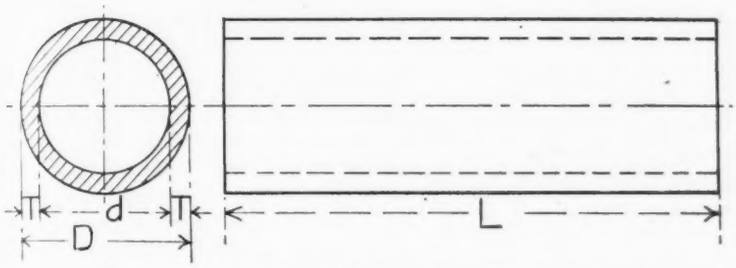
FORMULAS FOR FINDING THE WEIGHTS OF IRON CASTINGS



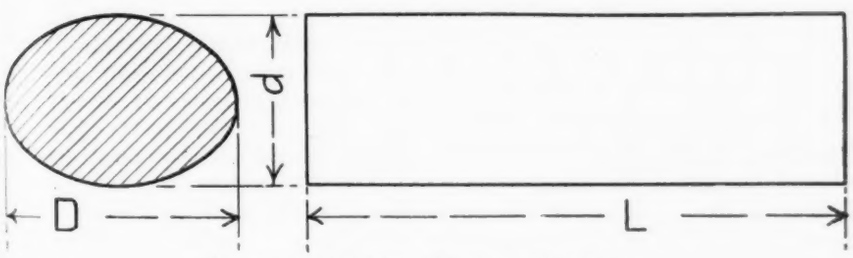
No. 1—Solid, rectangular castings—W=L×B×T×0.26



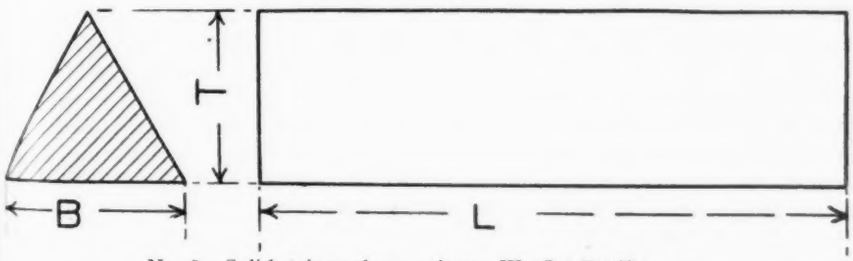
No. 2—Solid cylinder—$W=D^2\times L\times 0.204$



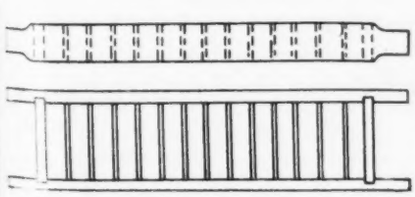
No. 3—Hollow cylinder—$W=(d+T)T\times L\times 0.817$



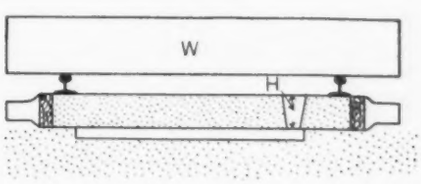
No. 7—Solid ellipse—$W=D\times d\times L\times 0.204$



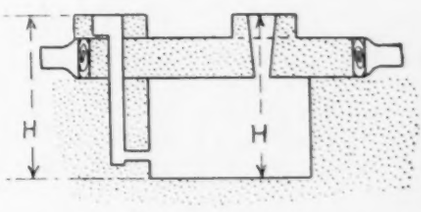
No. 8—Solid, triangular castings—$W=L\times B\times T\times 0.13$



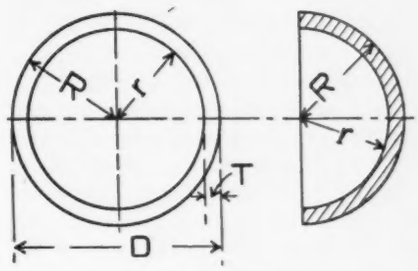
No. 9—Weight of body of rammed sand—$W=L\times B\times H\times 87$



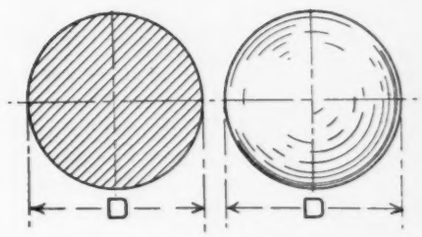
No. 10—Weight required on cope when casting—$W=A\times H\times 0.21$



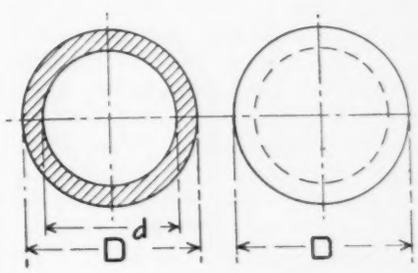
No. 11—Pressure exerted on mold by molten iron—$P=H\times 0.26$



No. 4—Hollow hemisphere—$W=\left(r+\frac{T}{2}\right)^2 T\times 1.652$



No. 5—Solid sphere—$W=D^3\times 0.1365$



No. 6—Hollow sphere—$W=(D^3-d^3)0.1365$

problem. At first sight it would appear as though we should find the cope area of the arms and multiply this by their depth below the top of the riser, and from this get the lifting force, but a little careful thought will make it clear that this lifting area is only equal to their large diameter. This is shown quite clearly in Fig. 3, which also shows that the same principle applies to solid cylinders, etc. It is also shown on this sketch that the lifting force on a cylinder equalizes at a point about one-third of the diameter above the joint. In the case of large or deep cope projections, this amount should be subtracted from the depth of the cope and the problem treated as though the joint of the mold were situated at this point, thus assuming that we were making a cylinder 21 inches in diameter, 40 inches long, in a cope 20 inches deep, and we would take one-third of 21 or 7 inches from the depth of the cope and figure as follows: 21 inches × 40 × (20 — 7) = 10,920 cubic inches, and this would give us 2,839 pounds, this being the cope lifting force exerted by such a solid cylinder if cast on its side. However, in the problem at hand the vertical diameter is so small as to render such allowance unnecessary. Another feature that must not be overlooked is that the joint of these arms is located 5 inches below the cope surface of the rim and thus are 17 inches below the riser top. We will consider the lifting force of each arm to be equal to the weight of a casting 6 inches wide, 17 inches thick, 42 inches long, and this casting would weigh 42 × 17 × 6 × .26 = 1,113.84, or 1,114 pounds, this being the lifting force of each arm and 6 × 1114 pounds = 6,684 pounds, is the lifting force of the six arms. The total lifting force of the wheel will therefore be 1410 + 14118 + 6684 = 22,212 pounds. In every-day practice therefore, 22,200 pounds would be an absolutely safe weight to place upon this cope. However, if it is desired to figure more closely, a rough weight of the cope can be found by using Formula 9, W = L B H 87 and substituting W = 12 × 12 × 1 × 87 = 12,528 pounds.

This does not take into account the weight of the hanging sand for lifting down to the arms, but this can be ignored, and we thus have 22,212 — 12,528 = 9,684 pounds, and adding 25 per cent as a safety factor, we have 12,105 pounds. It is the writer's opinion, however, that this weight is too close for good practice, and that the weight of the cope should be ignored. If a heavy fin were formed around the casting it would serve to naturally increase its lifting force by increasing the cope area of the casting, and might thus result in its loss.

Another illustration of the weight of copes is found in the kettle shown in Fig. 1.

Example No. 19.

Find the weight necessary to place upon the cope of a kettle of the shape and dimensions previously given, cast with the core suspended from the cope, and assuming the top of riser to be 10 inches above the top of the casting.

In solving this problem, we shall ignore the weight of the sand and will consider the bottom part of the core as one-half of a solid ball, 38 inches in diameter, the straight part of core as a solid cylinder 38 inches in diameter and 30 inches long, and the cope lift as a solid cylinder 50 inches in diameter and 10 inches long. The formula for finding the weight of a solid ball of cast iron, $W = D^3 .1365$, and substituting, $W = 38^3 \times .1365 = 7{,}486$ pounds, and one-half of 7,486 = 3,743, this being the amount of iron which is displaced by the bottom part of the core.

The formula for finding the weight of a solid cylinder is No. 2, $W = D^2 L .204$, and substituting, $W = 38^2 \times 30 \times .204 = 8{,}837$, this being displacement of straight portion of core, and using the same formula again for the lifting force on the cope, and substituting $W = 50^2 \times 10 \times 204 = 5{,}100$ pounds. The total is 3743 + 8837 + 5100 = 17,680 pounds, this being a safe weight to place upon such a flask.

Weight of the Sand.

In cases like the foregoing, if it is desired to find the approximate weight of the sand, multiply the weight in iron by .2 and the result is the weight of the sand; or, as iron is five times as heavy as sand, take one-fifth of the weight in iron. In this case, the weight of the sand which displaces the iron is, therefore, 17,680 × .2 = 3,536. We will next consider the pressure exerted on the bottom or sides of a mold by the liquid iron during pouring. This is determined by the distance between this point and the top of the riser and can be found by using Formula 11, P = H .26 in which P = pressure in pounds per square inch, H = height from the point desired to top of riser.

Example No. 20.

Find the pressure exerted upon each square inch of the bottom of a mold if the top of the riser is 60 inches above, substituting, P = 60 × .26 = 15.6 pounds. This does not appear to be excessive and yet if the bottom surface of such a mold were 8 inches square then the pressure exerted would be 8 × 8 × 15.6 = 998 pounds, or if we consider the ramming of a mold of this depth and assume that a butt rammer 3 inches square were used, then the blow that it would be necessary to strike to ram the sand sufficiently hard to withstand the pressure would be 3 × 3 × 15.6 =139.4, or 140 pounds.

Force of Ramming.

As we have no means at hand to measure the force of a ramming blow the latter may not appear to be of much practical value, but even at present such knowledge is useful to the molding machine builder or operator, and it further serves to show that mathematics may some day be applied to a great many problems in foundry practice which at present are based entirely on the skill and judgment of the molder.

In conclusion, the formulation and use of simple rules leading to this result will enable the foundrymen to make use of their education and will do more toward raising the mental standard of our molders than any other factor possibly can, besides doing away with a large amount of the uncertainty which at present attends foundry work.

FOUNDRY COSTS.

R. H. Postlethwaite, superintendent of the Risdon Iron & Locomotive Works, San Francisco, describes the following simple method of obtaining foundry costs, in *The Monthly News-Letter*, published by the California Metal Trades Association:

Among the various departments of which a large shop is made up, the one for which costs are most easily kept is probably the foundry; that is, if the average cost of castings is required and the system does not go into a close segregation of the various classes of castings made. At the same time, judging from some of the figures quoted for castings during the last few years, it is evident that some of our members have not kept any sort of shop costs. Unless a foundryman knows what the costs really are, which go to make up the finished cost of a casting ready for delivery out of the foundry, there is a great temptation to keep on under-bidding, until the foundry finds itself in receivers' hands. If the real cost of a casting is unknown, when "B" hears that "A" has bid 2¼ cents for certain work, he jumps to the conclusion that if "A" can make a profit at that figure,

h can bid 2½ cents next time the same work is on the market. It is exactly this sort of bidding that has helped to ruin the foundry trade in San Francisco; and this price cutting would not be indulged in if everyone knew that the particular casting bid on could not be produced for less than an actual cost of say, 2⅞ cents per pound.

Division of Costs.

The cost of castings may be divided under the following heads:

(1) *Fixed Expenses*—Under this heading comes general expense—taxes, advertising, telephones, telegrams, employers' liability, depreciation and interest charges.

(2) *Fixed Salaries*—Including foreman, clerk and weigher, cupola tender and helper, and craneman.

(3) *Power*—Including water, light, crane and blower.

(4) *Wages Not Charged Direct to Jobs*—Such as general helpers and flask-makers.

(5) *Charging Materials*—Including pig iron, scrap, ferro-manganese, ferro-silicon, etc.

(6) *Sundries*—Such as brick, sand, flour, etc., and upkeep and repairs to buildings and equipment.

(7) *Fuel*—Coke for cupola and core ovens.

(8) *Cleaning Castings.*

(9) *Wages Charged Direct to Jobs*—Including molders, coremakers, helpers and apprentices.

Items Nos. 1 and 2 remain almost fixed for any certain foundry irrespective of whether it is running full or light.

Item No. 3 varies slightly with the output.

Item No. 4 increases less rapidly than the increase of output.

Items Nos. 5, 6, 7, 8 and 9 vary almost in proportion to the output.

The accompanying table is a *pro forma* month's cost of a typical foundry with a maximum capacity of 250 tons per month, and probably represents somewhat closely the average conditions existing in San Francisco:

Cost Chart.

A graphic representation of the monthly costs will be found most convenient, as it shows at a glance a change in any one item. The accompanying diagram is supposed to represent a four months' run of the typical foundry. You will note how readily this chart shows that the cost of castings varies materially with the increase or decrease of output. It also shows the effect the percentage of good castings, compared to the total melt, has upon the ultimate total cost. This percentage should be taken into consideration when figuring the total cost of a casting. The criticism will probably be made that the upper line, showing the total cost, only gives the average cost of all the castings put through the foundry, and therefore is not of any great value in estimating on particular jobs. To meet this I have shown the line marked "Cost of Melt," which is the total cost of all items except "Wages Charged Direct to Jobs." This line, therefore shows what may be called the actual cost of the castings, less the molding and can be used as a basis for making up an estimate on any particular job. The estimator can readily figure the amount of wages which will be paid to the molders, coremakers, helpers and apprentices actually working on the job, which added to the melt cost will give the true cost of the job.

This method of estimating eliminates a great deal of guess-work, and if followed out would prevent a foundry unknowingly bidding below cost.

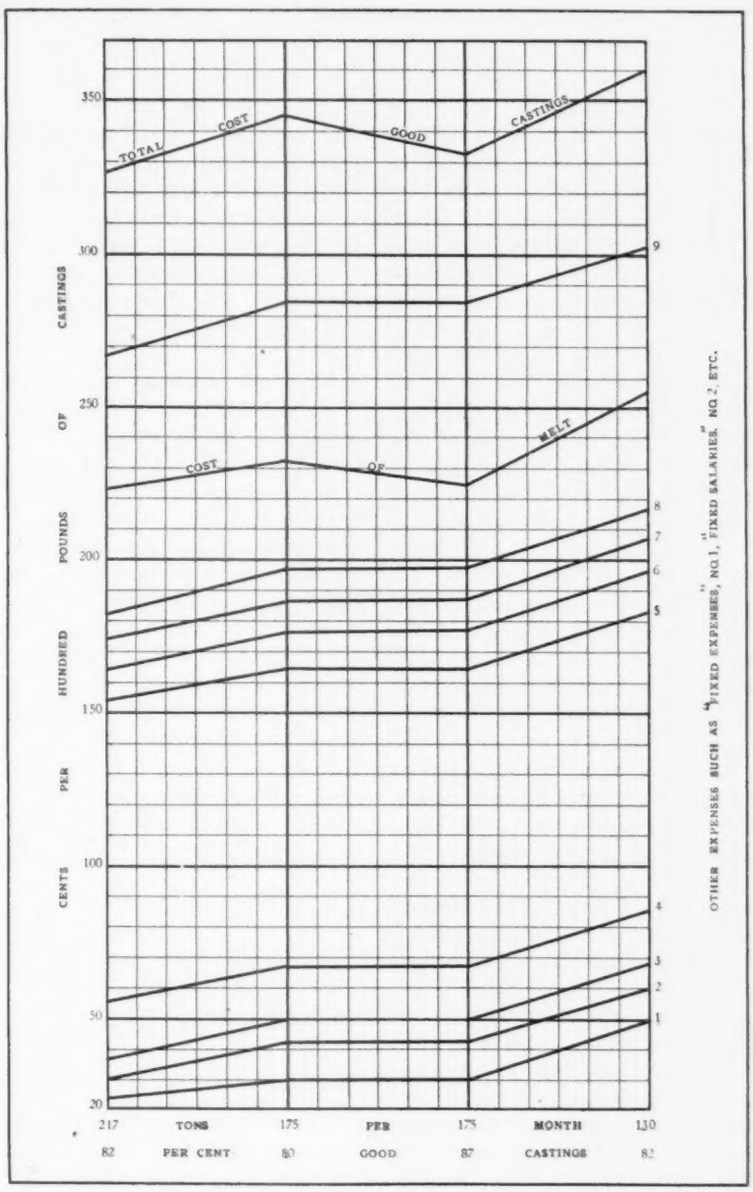


DIAGRAM SHOWING THE DISTRIBUTION OF COSTS OF A FOUR MONTHS' RUN OF A TYPICAL FOUNDRY

DISTRIBUTION OF MONTHLY COSTS.

		Cost in cents per 100 pounds run from cupola.
1. Fixed expense	$1,200.00	22.66
2. Fixed salaries	480.75	9.07
3. Power	260.50	4.92
4. Wages not charged to jobs	980.06	18.50
5. Charging materials	5,111.76	96.51
6. Sundries	686.55	12.96
7. Fuel	542.40	10.24
8. Cleaning castings	371.67	7.02
		181.88 ÷ 82 = 2.22 "Melt."
9. Wages charged to jobs	4,532.39	85.56 ÷ 82 = 1.04
	$14 166.08	267.44 ÷ 82 = 3.26
Total run from cupola during month		529,634 pounds
Total weight of good castings		434,300 pounds or 217 tons
Percentage of good castings, 82 per cent.		

AN INTRICATE MACHINE PATTERN PLATE

How the pattern for an automatic machine casting was mounted on a roll-over molding machine

BY F. W. HALL

THE mounting of the intricate automatic machine casting shown in Fig. 1, on a molding machine, was brought about in a very interesting way. A new patternmaker had just been employed by the foundry, which had the contract for this work and no molding machines were used. He advocated the mounting of a number of patterns on machines, but little attention was given his suggestions until a strike was threatened among the molders. The manager then called upon the patternmaker for information regarding the number of patterns that could be profitably mounted on machines and after a consultation with the foundry foreman it was decided to try this job, which was the most difficult one then in the foundry. For a long time these castings were made in three-part snap flasks, 60 molds being considered a good day's work. After they were mounted on the machines, however, 160 molds were successfully made. The work of mounting this pattern proved exceedingly difficult, owing to the two horns or projections shown at *A*, Fig. 1.

Making the Pattern.

In proceeding to mount this pattern, the size of the flask was first determined. The over-all dimensions of the pattern were 6⅛ by 10¼ inches and a clearance of 1½ inches around the pattern was considered sufficient. Providing for this allowance, it was decided to use a standard size flask, 10 x 14 inches. This provided a sufficient space for building the parting line up from the flask line to the arms *E*, shown in Figs. 1, 2 and 3. As the roll-over machine was limited in width, and inasmuch as only two parts of the casting were difficult to make, they were placed side by side on the frame as shown in Fig. 9. A slight change was also made in the lever of the binding rod *V*, Fig. 8. The exact locations of the parting lines and the divisions between the drag, cheek and cope were next determined. The drag contained the two projections *A*, the interior of *C*, the middle foot *F*, and the pocket *H*, as shown in Fig. 1. This included that section above the top face of the pattern and the inside of the two pockets. The remainder of the pattern with the exception of that portion marked "ground finish," Figs. 1 and 3, was placed in the cheek. The cope contained the top face of *C*, together with the sprue, and the bevel extension on top of section *C*. In Figs. 2 and 5 is shown the drag in plan and side elevation on the line *K-L*, Fig. 1.

After the drawings were completed, patterns were made of the three plates, which were about ½ inch thick in the center, with a thickness 1 inch square around the edges for strengthening them. At each end, ears were placed for the flask pins. A line was scribed through the center of these ears across the plate and from this the layout of the outline of the pattern was drawn. The pattern was built up by blocks *P*, Fig. 6, from the outline which started where the side of the arm *E*, Fig. 2, joined the main section of the pattern *G*. From these points was laid off the line *P-P*. This was continued to a point within 5-32 inch of the outline of arm *F*. Another line was scribed 5-16 inch from the line *P-P* until it joined the pattern and continued the same distance from the outline of the arm F. This outline is designated as *Q*, Fig. 2. As can be seen by referring to Fig. 9, by cutting out this wooden plate to these lines the depth of the same was 5-16 inch below the parting line of arm *E*, designated by *X-X*, Fig. 5, and the line with the 5-16 inch allowance is designated by *K-Y*. With the outline cut out in these two pockets the necessary sections of the pattern arm *F* that form a part of the drag section were made. Section *B* was made so that it could be placed through the drag plate in its proper location, the main object in having this section loose being to permit of the planing of the flat plate perfectly true. Section *B* passed through the plate, with its flanged section resting on the upper face of this plate, and a hole was cut through the pattern plate so that B would pass through without unnecessary finishing of the opening. The pocket H, Fig. 1, was cut through the plate and a file finish allowed. Another plate was

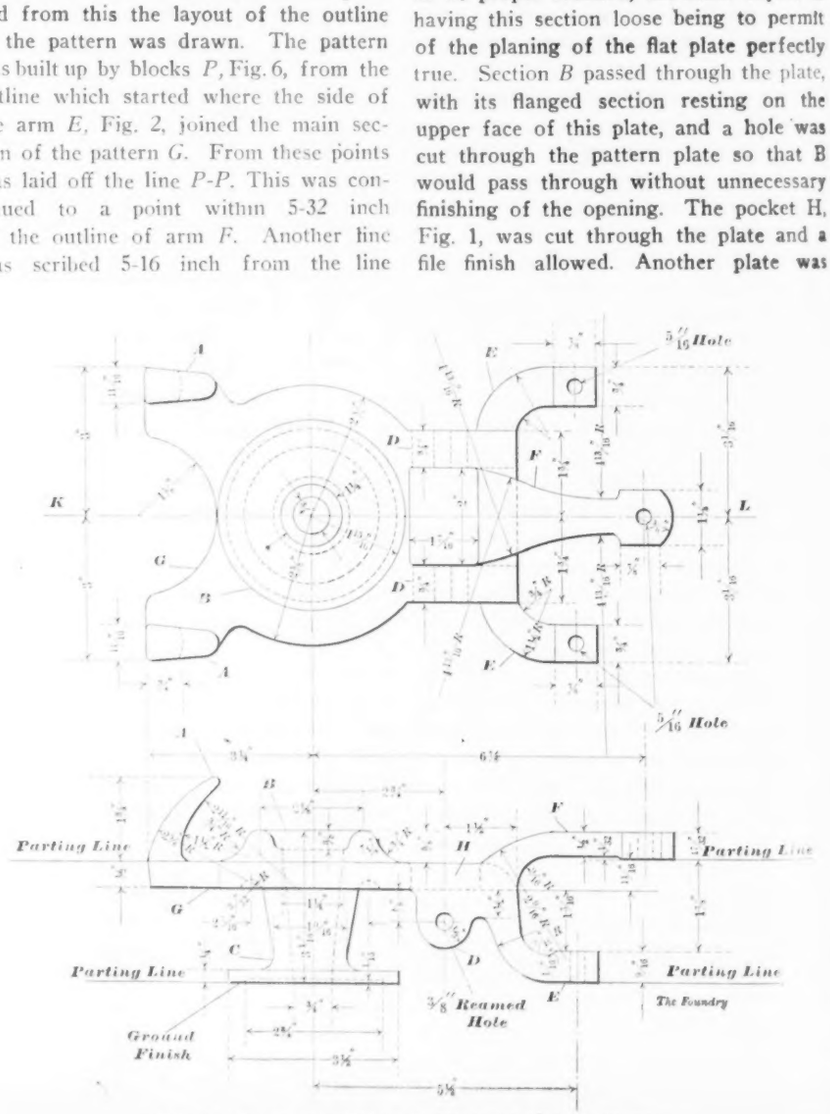


FIG. 1—PLAN AND CROSS-SECTION OF THE CASTING

screwed to the under side of the pattern plate, closing this opening.

Patterns of the Projections.

The making of projections *A* was then taken up. These were to be stripped and rotated out of the mold so as not to disturb the sand. In laying out this part of the work it was found that the radii of these projections extended slightly underneath the face of the plate and it was concluded that in order to rock these projections out of the sand they should rock on the point of their greatest radius. Patterns of the projections were made of sufficient length to pass through the plate. Means were provided for holding and operating these projections when desired from the under side of the drag plate by two ears designated as *A-X*, Fig. 9. These were made separate and fastened to the iron plate. The openings in the drag plate for the projections to pass through were then laid off and cast in, a finish of 1-16 inch being allowed. This practically finished the drag section.

The cheek plate, on which the greater portion of the pattern was mounted, was made to conform with that of the drag so far as the arms *E* and *F* are concerned. Two building-up blocks were made right and left hand, their outline conforming to the lines *P* and *P-P*, Fig. 3. These lines are 5-16 inch inside of the line *Q*, Fig. 2. These blocks form the parting line between the two sand bodies and govern the shape of the arm *E*. As the arm *F* extends slightly under the parting line, Fig. 1, the cheek plate was cut out to this extent, the section removed being the shape of the arm *F* and its outline was such as to match up the building-up blocks *F-B*, Fig. 9, at the section of the pattern that rested on these blocks, and the cheek plate shown at *T*, Fig. 9. On this section was placed a runner that extended to a point on a level with the top of the cheek flask. The under side of the patern *G*, as well as the blocks that rested on the cheek plate, were made slightly concave, so that the outer edges rested on the plate. The outer section *C* was made in the cheek flask as well as a part of section *G*, and only the section marked "ground finish" was made loose from the smaller section. The point of separation was at the smallest diameter of the neck *C*, and the splitting of the pattern at this point was to permit its being drawn from the sand in the cheek mold. As this loose flange must be set in the same location with each operation, it was recessed. It will be noted that this flange, shown in Fig. 6, contains an extra amount of material over that shown in Fig. 1. This was allowed for the purpose of extending its top face to the top of the cheek mold, this being necessary in order to permit of its withdrawal from the sand. Two lugs are shown at *D* which are made a part of section *G*.

On the center line of the cope plate, Fig. 4, was laid off the location of section *C*, Fig. 1. The recess in the cope is marked *H-H*. The sprue was made to rest on the cope plate directly over the

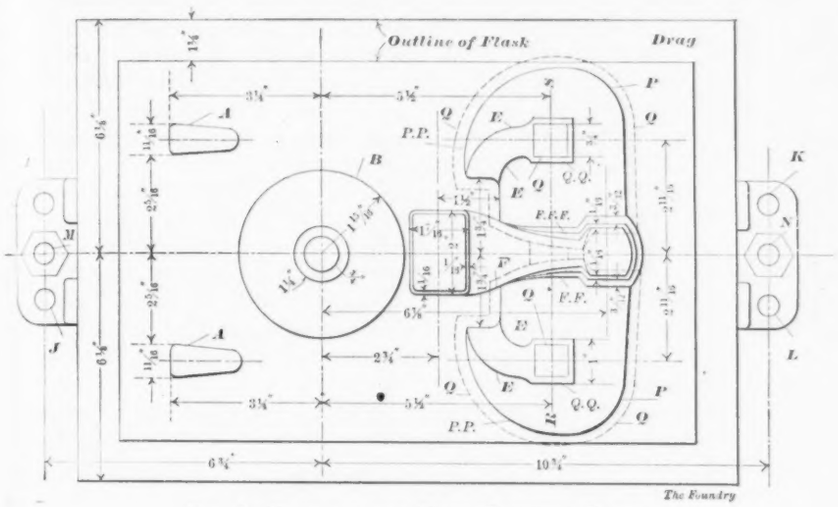


FIG. 2—PLAN OF THE DRAG PATTERN PLATE

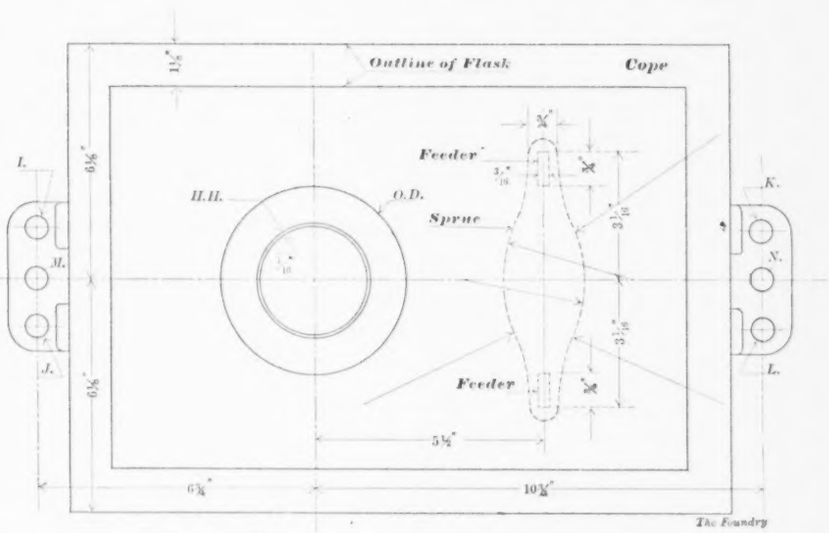


FIG. 4—PLAN OF THE COPE PATTERN PLATE

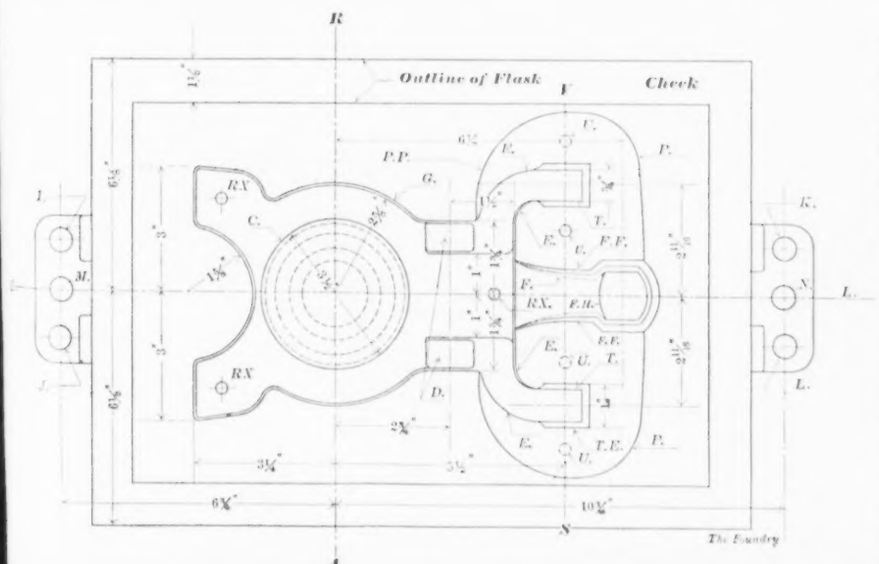


FIG. 3—PLAN OF THE CHEEK PATTERN PLATE

top of the arm *E*. The location of the sprue is shown in Figs. 4 and 7.

Metal Patterns.

From these wooden patterns the metal patterns were made. Starting with the cheek plate, the center line *C-L*, Fig. 3, was scribed. The center of the plate was next determined and as it was decided to make the job in a snap flask, 10 x 14 inches, and the flask out of lumber 1⅛ inches thick, the total length of the plates, not including the flask pin ears, was 16¼ inches. As the pattern was 10¼

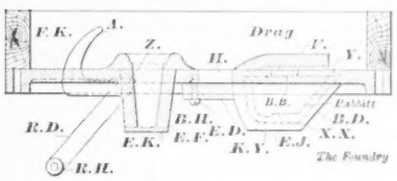


FIG. 5—CROSS-SECTION OF THE DRAG FLASK

inches long it was determined that it must be located 2¾ inches from the ends of the plates. This provided for a sand wall, 1⅝ inches thick. The flask pin centers were then determined, which in this instance were ⅞ inch from the outside of the flask. As *B*, Fig. 2, was 6 inches from the outside of the flask, little difficulty was experienced in laying off the center of *B* on the three plates and from this center all other points were correctly determined. Section *G* was then fastened with the screws *R-X*, Fig. 3, and the building-up blocks *F-B*, Fig. 9, were then placed on the cheek plate. These blocks were placed against the end of section *G*, so as to fit underneath the arm *E*, Fig. 1. The loose flange *C* was then fitted on the main section of *G* and on top of the arms *E* the feeders were placed, their location being shown in Fig. 4. These feeders were 3-16 by ¾-inch and were made with a slight draft so that they could be easily removed from the sand. They were made long enough to come flush with the top of the cheek flask. As section *G* and arm *E* must be removed from the plate and the blocks, leaving only the latter, so that the drag plate could be babbitted, this plate was stripped and the making of the drag plate was begun.

As the drag plate was already drilled for the flask pin holes it was an easy matter to locate it accurately over the building-up blocks. The inside of the cavity which was made to receive the impression of the building up blocks was then drilled and nails were inserted leaving ⅛ inch protruding. A pouring hole was then drilled through the drag plate through which the white metal was poured. The two plates were then clamped together with the drag section uppermost. The metal having flowed around the nail heads, adhered firmly in the drag plate and made a perfect fit around the building-up blocks. Arm *F* and section *B* were then placed on the plate in their proper location, this being determined from the center line *M-N*, Fig. 2. The plate *E-D* was then placed over the opening *H* on the under side of the drag plate and was held in position by the screw *B-H* and two dowel pins, and the plate *E-K* Fig. 5, was also placed underneath the opening *B*. Section *A* was next laid off and accurately located. Two holes were drilled in the projections and two similar holes in the ears *A-X*, Fig. 9. Two wrought iron levers *R-H*, about 5 inches long, were then provided and two rivets were passed through the section *A-X* on which the projection rocked. Cross rods *R-D* connected the two ends of the levers. To adjust the projections, set screws were provided. After a mold had been made and it was found that the projections were in their proper locations, the projections were fastened to the shaft to prevent moving.

Cope Plate.

The cope plate was then made. The circle *O-D*, Fig. 4, was then scribed from predetermined centers and the opening in the plates was then filed to conform with the angle of *C*, Fig. 6. A piece of steel was then fastened at the bottom of the opening in the cope plate. The location on the flat surface of the arm *E* was then determined for the location of the sprue and the feeders. The cheek and drag plates were then fastened to the frame of the roll-over machine. Some slight changes were made in the machine, which was provided with a lever to fasten the bottom board and the flask to the pattern plate while being rolled over. As there were two flasks on the machine a new lever was made, designated *V*, Fig. 8. This held two flasks in place instead of one, *J-D*, Fig. 9, being used for the drag and *V-A* for the cheek. These were connected by the rod *V-B* and were operated by the handle *W*, and while rolling-over, the machine operator held the handle *W* and the lever *V-B*. In Fig. 8, the flasks are shown rolled over, the rocking frame being shown in dotted lines, as it would appear when rocked away from the mold,

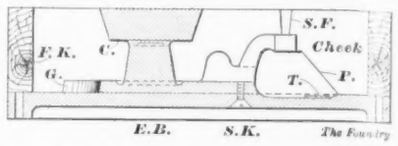


FIG. 6—CROSS-SECTION OF THE CHEEK FLASK

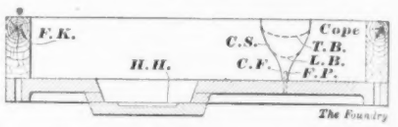


FIG. 7—CROSS-SECTION OF THE COPE FLASK

drawing the pattern at the same time. Before this can be done, however, the projections must be withdrawn from the same, this being accomplished by the levers provided for this purpose.

THE VALUE OF SCRAP COPPER.

By A. S. Atkinson

Scrap metals form an important item in the world's manufacturing supply of raw materials. In recent years various processes have been devised for the reclamation of non-ferrous scrap metals, and today millions of pounds are returned to the foundries for remelting. Not all scrap metals are of equal

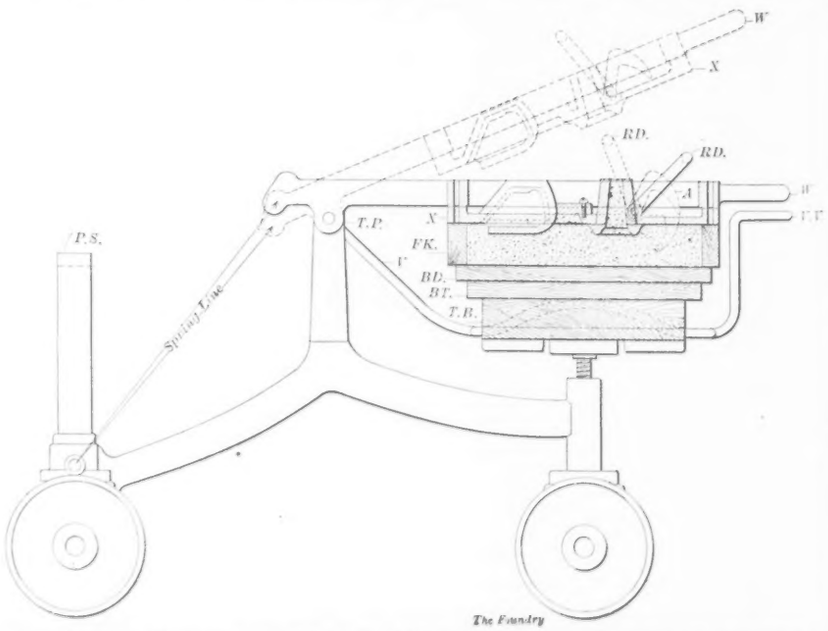


FIG. 8—SIDE ELEVATION OF MOLDING MACHINE SHOWING FLASKS IN POSITION

value, and the success of handling this material depends almost entirely upon a scientific knowledge of the relative values of the various articles scrapped.

Among the scrap metals, copper wire is considered the most valuable for recovery purposes for the reason that it is made of almost pure copper. Most of the other articles that find their way to the old material market contain varying percentages of alloy metals, which make it more difficult to recover the copper. The amount of copper wire used annually is enormous and, therefore, a large quantity is annually scrapped. The Bell telephone system alone has upward of 5,000,000 miles of copper wire in use, and to this should be added the product of the electrical transmission companies, street railways, telegraph and independent telephone companies. One large switchboard in an important central station contains as high as 4,000 miles of wire.

Scrap Valves.

Next to copper wire, scrap valves command the highest prices from brass foundries. These valves are usually made of the best material, and no class of brass castings is made with more care. Valves that can pass the rigid inspection to which they are subjected must be of good composition, the standard mixture usually consisting of 86 per cent copper, 4 per cent zinc, 7 per cent tin and 3 per cent lead. Valves of a lower grade contain more lead and zinc and less copper and tin. Scrap cocks are not as desirable as valves, and they command a lower price in the old metal market. When purchasing brass valves, however, it should be remembered that the wheels are made of iron and should be carefully excluded. If first class copper metal is desired, brass valves can usually be depended upon to contain a high percentage of copper.

While generally believed that the electrical companies are the largest consumers of copper, and that the scrap copper finds its way chiefly back to them, nevertheless there is a large brass foundry in the east that uses approximately 125,000 pounds of copper annually. The next largest user of copper is said to be the General Electric Co., which requires about 70,000 pounds of metal annually, and the Westinghouse Electric Co. is reputed to be a close third in the purchase and consumption of copper. Electrical concerns, as a rule, depend chiefly upon new copper, but to a large extent reclaim all of their own scrap metal.

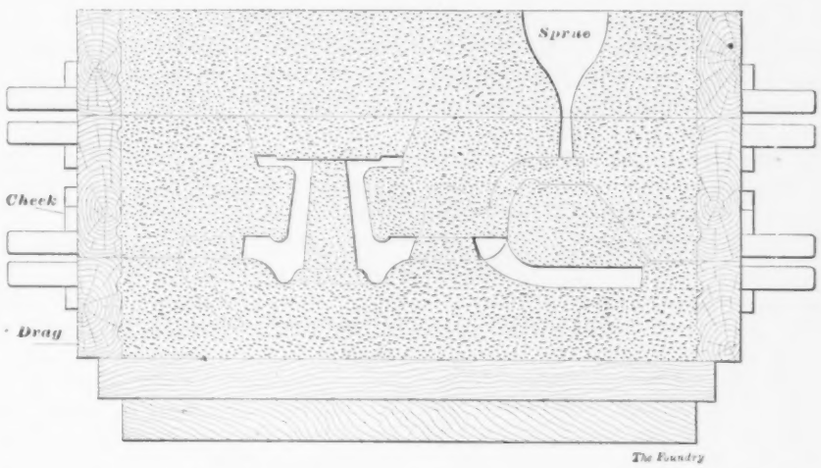


FIG. 10—CROSS-SECTION OF THE FINISHED MOLD

Brass founders, however, are the largest purchasers and consumers of scrap copper and brass. It is to their interest to purchase as much of this material as possible, in view of the fact that it can be secured at a price considerably lower than new copper, although in recent years, at times, it nearly approached the quotations on new metal.

Sources of Scrap Copper.

Aside from the electrical industries, copper and brass enter largely into our modern life, and the field for collecting scrap is enormous. The roofs and cornices of sky-scrapers are made of sheet copper, and contractors who make a specialty of wrecking old buildings, depend to a large extent upon the metal thus recovered. Sheet copper has come into general use in recent years, since modern methods of manufacture have made rolled copper sheets available at moderate prices. Architects appreciate the value of this material both for ornamental and fireproofing purposes. In the east, sheet copper has been used extensively for sheathing ferry and railroad buildings on water fronts. The use of sheet copper on these buildings is due to peculiar local conditions. Erected on the water front, the only foundation beyond the bulk-head line is

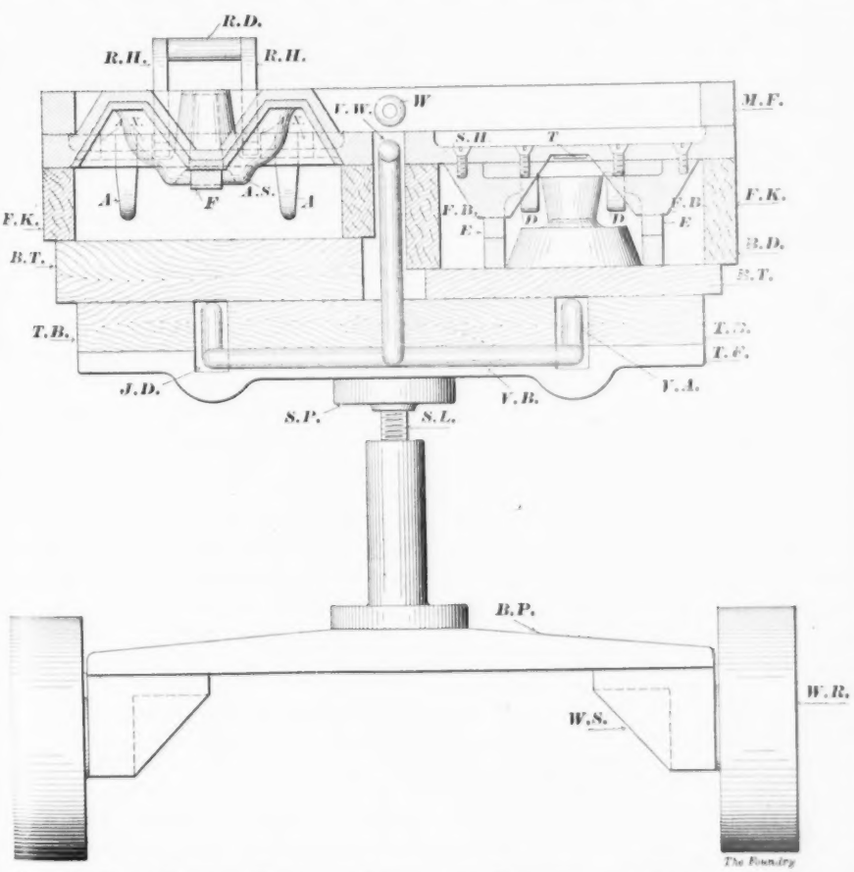


FIG. 9—CROSS-SECTION THROUGH CHEEK AND DRAG FLASKS, MOUNTED ON THE MOLDING MACHINE

soft mud for a considerable depth. The fronts of these buildings must, therefore, be constructed of some light material, both fireproof and ornamental. For a time, architects believed sheet copper unsuited for this purpose and built fronts of these buildings of wood, or made them of a metal frame work sheathed with wood. Recently erected ferry houses, however, are provided with sheet copper fronts, and while the metal frame work of several of these buildings has settled several times, the copper superstructure shows no evidence of change. The Lackawanna railroad ferry house at Hoboken, N. J., has a tower consisting merely of a shell of copper secured directly to the steel frame work, and there is no further backing of any kind.

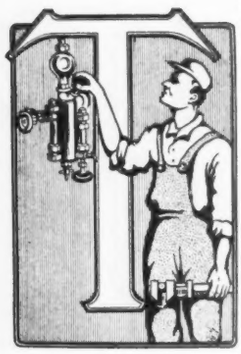
Owing to atmospheric conditions, iron and steel exposed to the weather in the vicinity of the North river, rust rapidly and require frequent repainting. Sheet copper, on the other hand, is not attacked. Experiments are now being conducted by several manufacturers of sheet copper with a view to giving this metal a verdigris finish, which will withstand the weather. The idea prevails that if copper is exposed to the weather for a considerable length of time, it will soon acquire a beautiful green coating. This, however, is a misconception. Soft copper, after an elapse of years, acquires a beautiful color, but hard rolled copper darkens with age and frequently turns black. The copper surface can be treated with acid to secure a verdigris finish, but the copper salt thus formed soon washes off, leaving the black surface exposed.

The scrapping of ornamental fronts of buildings and ferry houses will, in time, gradually add to the amount of metal that ultimately finds its way into the scrap metal market. The constant increase in the use of copper will also result in a corresponding increase in the amount of old material available. Architectural copper and brass are in use much longer than the non-ferrous metals used in the machinery and engineering industries. Brass and copper machinery parts are subjected to considerable wear and must be frequently renewed. Architectural copper and brass, on the other hand, may last indefinitely and, therefore, the new metal used in this line of work is also permanently removed from the market.

Since the value of scrap copper has advanced sharply in recent years, efforts are being made to ascertain the amount annually recovered, as this is a factor which producers of the new metal must carefully consider.

BRASS VALVE AND INJECTOR MIXTURES FROM AN OLD MEMORANDUM BOOK

BY JAMES M. BETTON



THIRTY years ago, the manufacture of brass valves and plumbers' goods generally, was carried on principally in the New England states, and while competition was keen, the volume of business was exceedingly large and very profitable. Today, only a few of these concerns are still in existence, as many of them have passed into other hands, and in the consolidations of recent years many of the firm names were dropped. Early in the 70's, a large brass foundry was located in a small New England village, there being but one other manufacturing plant in that community—a cotton mill, and both obtained their power from the same small stream. Considering the period, this shop was modern in every particular, having replaced the original foundry, which was destroyed by fire.

Arrangement of the Foundry.

The works extended along the bank of the stream and at one end of the yard was the dam, while the foundry was a one-story building, equipped with 24 natural draft melting furnaces. The stack of this battery of furnaces was so constructed that two boilers could be connected with it to utilize the waste heat and to furnish steam for heating and auxiliary power. This arrangement, however, was never carried out, as it was believed that the fumes and gases from the furnaces would destroy the boiler plates. The finishing shop was a large building several hundred feet in length, two stories high, and other buildings included the pattern shop, storehouse for metal, sand, etc., shipping department and office building. The arrangement of the plant carried out the general plan of receiving the raw material at one end and shipping out the manufactured product at the other.

It is not within the scope of this article to enter into the details of the manufacturing processes but piece-work prevailed, and new tools were installed from time to time as rapidly as they were placed on the market. While bench molding prevailed throughout the foundry, several molding machines were later introduced. The labor was principally American and Irish, with the exception of the yard laborers, who were French-Canadians.

Every effort was made to prevent the employes ascertaining the contents of the various mixtures, and it was the practice to cast the base metals, such as copper, tin and zinc, into small ingots, in varying proportions, which were later broken up for the mixtures. These were known as composition ingots, but were used to great advantage by the melter. There was necessarily a loss in the first melting, of which no record was kept, although the figures presented herewith show the shrinkage in the remelting. Sprues were cut with a chisel until a power cutter was designed and installed.

It was customary to stir into each pot of metal, just before pouring, a small piece of stick phosphorus, which was kept in a basin of water on the foreman's desk. For a long time the nature of this material was kept a secret, and was necessarily carefully handled by the men. From experience, they knew that its use insured a freely flowing metal, and one venturesome molder who pocketed a small piece as he passed out of the foundry at noon, had only a sad experience to relate.

Mixtures.

The mixtures, presented herewith, were used by this shop for many years with excellent results.

No. 1 Bibb was used for finished plumbers' goods, including basin and bath cocks, union joints, etc. The mixture contained 48 pounds of zinc, 33 pounds of tin and 39 pounds of lead.

This was cast into ingots and was known as the composition mixture. It was used in the proportions of 6¼ pounds to 40 pounds of ingot copper, or 2¼ ounces to one pound of copper.

No. 2 Bibb was used for ordinary basin cock trimmings, globe valve trimmings, etc. It was made up of 40 pounds of turnings, 10 pounds of copper and 4 pounds of No. 1 Bibb mixture. Before they were used, the turnings were passed through a magnetic separator to remove iron filings.

Yellow Brass.

The yellow brass as used in this plant for plumbers' goods contained 40 pounds of turnings, 14 pounds of ingot copper and 7 pounds of zinc.

Another formula for No. 2 Bibb follows: Zinc 45 pounds, lead 30 pounds, tin 8 pounds. This was cast into ingots and the resultant mixture was made up of 4 pounds of this composition, 40 pounds of turnings and 14 pounds of copper. Another No. 1 Bibb mixture contained 8 pounds of copper and 1 pound of the composition ingot metal, previously mentioned.

Steam Metal.

When steam metal for the best quality of steam cocks, gage cocks, etc., was made, composition ingots were first cast, containing 48 pounds of tin, 16 pounds of zinc and 12 pounds of lead. The steam metal mixture was then made up of 40 pounds of copper and 8 pounds of this composition metal.

Cost of Metal Mixture.

Another No. 1 Bibb mixture was made up of a composition cast into ingots, containing 25 pounds of zinc, 25 pounds of lead and 20 pounds of tin. The mixture was then made by the use of 1 pound of this composition to 8 pounds of copper. With spelter selling at 4½ cents per pound, lead 4⅛ cents, tin 15¼ cents, and labor approximating 5 cents per pound, this metal in 1879 cost 19.6 cents per pound.

In another No. 2 Bibb mixture, composition ingots were used in the proportions of 4 pounds of the ingot metal to 60 pounds of copper and 40 pounds of turnings. These ingots contained 45 pounds of zinc, 30 pounds of lead and 8 pounds of tin. This mixture cost 16 cents per pound, the metals and labor being quoted as stated above, while the turnings sold at 10 cents per pound. An ordinary brass mixture, frequently used in this shop, was made up of 40 pounds of turnings, 16 pounds of copper and 8 pounds of zinc. This mixture cost 15.68 cents per pound, with the metals and labor as previously stated.

Another steam metal, which was made up of a composition metal in the proportions of 1 to 8 of copper, cost 20 cents per pound, with the metal and labor as previously outlined. The composition contained tin 48 pounds, zinc 16½ pounds, lead 12 pounds. New brass was made up in the proportions of 2 of copper to 1 of zinc. This cost 16.8 cents per pound.

Loss from Remelting Turnings.

When remelting turnings, 50 pounds being charged into a pot, the records of this concern showed that 47 pounds of metal were recovered, the loss amounting to 3 pounds, or 6 per cent. From 50 pounds of washings there were recovered 44 pounds of metal, the loss being 6 pounds, or 12 per cent. From 16 pounds of emery strappings, there were recovered 5 pounds of metal, showing a loss of 11 pounds, or 69¾ per cent. This metal was used for hose couplings.

A further No. 2 Bibb mixture was made of a composition of 6¼ pounds of composition metal and 40 pounds of ingot copper, the composition ingot containing 48 pounds of zinc, 33 pounds of tin and 30 pounds of lead. A No. 1 Bibb was also made containing 2½ ounces of this composition to 1 pound of ingot copper.

Globe Valve Mixtures.

The following mixtures for globe valve bodies gave sound castings of good color:

(1) Ingot copper 40 pounds, zinc 3 1/3 pounds, tin 1 1/3 pounds, lead 1 1/3 pounds.

(2) Composition mixture 1 pound, copper 8 pounds.

The composition mixture contained tin 60 pounds, zinc 44 pounds, lead 34 pounds.

Still another No. 2 Bibb mixture was made up of 40 pounds of copper and 7½ pounds of composition metal, which contained 36 pounds of spelter, 30 pounds of tin and 15 pounds of lead. Another alloy of a similar nature contained 40 pounds of copper and 6¼ pounds of this composition mixture. This was also varied by the use of 12 pounds of this composition and 40 pounds of copper.

Metal Losses.

Accurate records were also kept of metal losses. A charge of 65½ pounds of scrap brass cocks gave: castings 42½ pounds, gates 14 pounds, and the spilled metal amounted to 4 pounds, while 3¾ pounds were left in the pot. The metal accounted for totaled 64¼ pounds, showing a loss of 1¼ pounds by melting.

A composition mixture of 65½ pounds when remelted showed a loss of 1½ pounds. The metal accounted for, follows: Castings 44¼ pounds, gates 13½ pounds, spilled metal 4¼ pounds, left in the pot 2 pounds. This was a scrap metal purchased in ingot form.

The loss in melting 86½ pounds of heavy brass amounted to 6¼ pounds, the metal being accounted for as follows: Castings 47 pounds, gates 28¼ pounds, spilled 2 pounds, left in the pot 3 pounds, total 80¼ pounds.

Light scrap brass, 73½ pounds, when melted showed a loss of 12¼ pounds, the metal accounted for having amounted to 61¼ pounds, divided as follows: Castings 36½ pounds, gates 14½ pounds, spelter ¾ pound, left in the pot ½ pound. Tests of ordinary working mixtures showed the following losses: No. 2 Bibb—Copper 14 pounds, pig metal 40 pounds, gates 12¾ pounds, composition metal 3½ pounds. Metal accounted for: Castings 36 pounds, spelter 4¾ pounds, gates 13 pounds, left in the pot 14½ pounds. The metal accounted for amounted to 68¼ pounds, showing a loss of 2 pounds.

No. 1 Bibb: The crucible charge contained copper 67½ pounds, composition mixture 8 7/16 pounds, gates 1 5/16 pounds. The metal was accounted for as follows: Castings 49¼ pounds, gates 17½ pounds, spilled 5½ pounds, left in the pot 3¼ pounds, or a total of 75½ pounds, showing a loss of 1¾ pounds.

Brass mixture, crucible charge: Copper 14¼ pounds, pig metal 40 pounds, zinc 7⅛ pounds, lead ½ pound, gates 3¼ pounds. The metal was accounted for as follows: Castings 45½ pounds, gates 13½ pounds, spilled 3 pounds, left in the pot 1 pound, or a total of 63 pounds, showing a loss of 2⅛ pounds.

Molding Costs.

For a period of 3½ years the cost of foundry labor averaged 3.809 cents per pound, to which 25 per cent were added for overhead expense, making a total cost of 4.761 cents per pound on brass and composition castings in quantity. The highest cost, without the 25 per cent addition, was 5.296 cents, and the lowest 2.937 cents.

The records show that the following piece-work prices prevailed for molding per flask in April, 1881:

	Hand, cents, per flask	Machine, cents, per flask
Large loose	5½	
Large sprue	4½	
Square loose	5	3⅓
Square sprue	4	2⅔
Small loose	4½	3⅓
Small sprue	3	2⅓

For molding globe valves the following prices were paid per flask:

Size, inches.	Hand Molding, cents per flask.	Machine Molding, cents per pattern.	Number of patterns on card.
⅛	6	—	—
¼	6	¼	16
⅜	6	⅜	16
½	6	⅝	8
¾	6	⅝	8
1	6	5/8	6
1¼	6	1⅜	3
1½	6	2½	2
2	6	2½	2
2½	6½	—	—
3	6½	—	—

Steam Metal Mixtures.

The mixtures given in the accompanying table were used successfully in a large brass foundry in the east, in the production of injectors, safety valves, etc., and will be found to give excellent results for work of this kind, insuring clean castings.

STEAM METAL MIXTURES.

	Copper, pounds.	Tin, pounds.	Zinc, pounds.	Lead, ounces.	Gates, pounds.
Injector barrels and trimmings	14	1⅛	⅞	4	
Injector jets	12	½	1	2	
Injector jet forcer	16¾	⅝	2¼	¾	
Locomotive injector barrels	10	1 1/16	7/16	2	
Locomotive rocker shafts and stems	12¼	1½	2		
Locomotive valves and overflows	6	1	3/16		
Gate metal, used as common	24	⅜	1 1/16	14	21 5/16
Pop valve bodies	8	1	¼	2	
Pop valve trimmings	18	⅜	1¾	8	28⅛
Locomotive injector levers and handles	14	2	⅝	2	
Locomotive injector forcer jets	7	1	¼		
Globe valves and stems	8	1	¼	1½	
Solder nipples	12		3	2	
Locomotive top bonnets	32	4	1	8	
Steam check valve bodies	8	1	¼	2	

Losses.

This shop was located in the loft of a building devoted to manufacturing purposes. The furnaces were of the ordinary, natural draft type and the output was small, but the percentage of bad castings was especially low, due largely to the excellence of the metals, careful superintendence, and the skill of the molders. The cost per pound of output was necessarily high as compared to that of foundries turning out a larger tonnage, but as the competition in those days was not as keen as at present, and as the profits on the finished goods were about 500 per cent, the high cost of production was negligible.

For a period of three months, Jan. 1 to April 1, 1882, the output of this shop was as follows:

	Pounds
January	16,250
February	19,556
March	18,372
Total	54,448

The daily output averaged about 600 pounds. The losses were as follows:

	Pounds
January	204
February	182
March	302
Total	688

The net output of good castings amounted to 53,760 pounds.

The labor cost during this period was divided as follows:

Coremakers	$1,235.36
Molders	1,349.45
Helpers	509.53
Superintendence	312.00
Total	$3,406.44

The expenditures for materials used during this period were divided as follows:

Sand	$ 38.00
Coal	110.00
Miscellaneous supplies	36.57
Tools, etc.	54.61
Charcoal	40.00
Rent	75.00
Crucibles	80.00
Wire	20.00

Cost of Castings.

From the foregoing, not including the metal, the following cost of castings per pound was obtained:

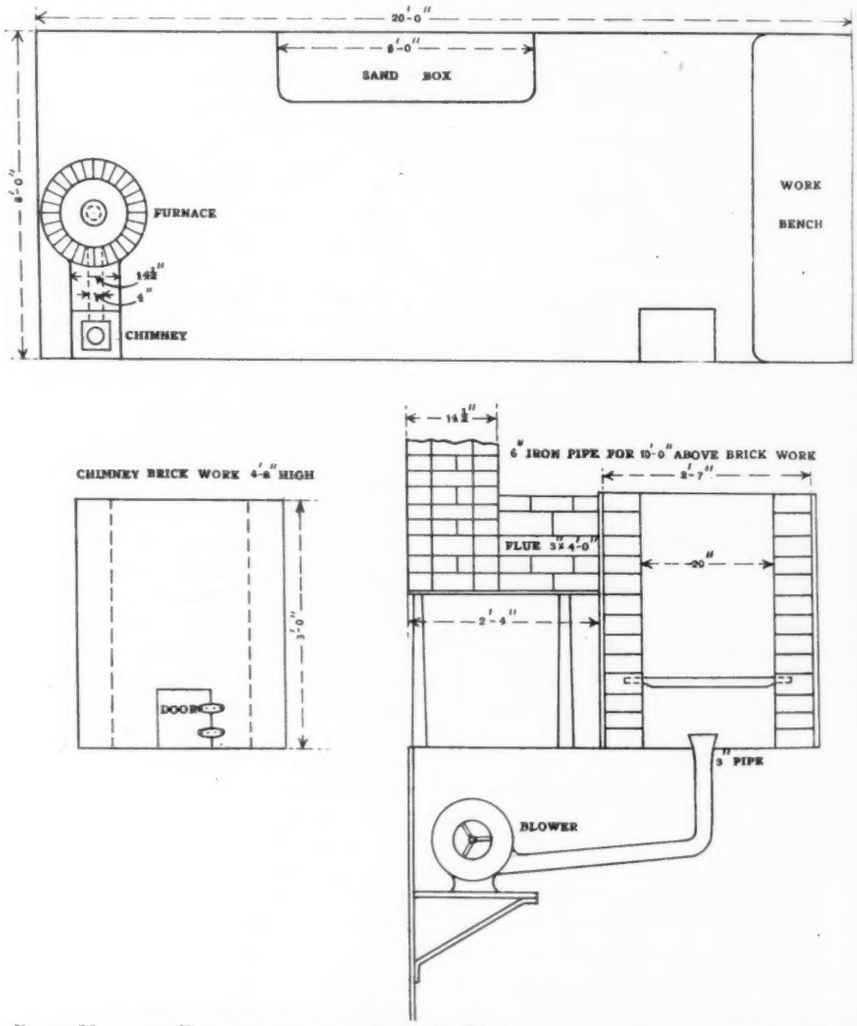
	Cents per pound.
Labor, molding, cores and help	5.73
Superintendence	0.43
Sand	0.07
Coal	0.41
Supplies	0.06
Tools, etc.	0.10
Charcoal	0.07
Rent	0.14
Water and gas	0.03
Crucibles	0.15
Wire	0.04
Total	7.21

A FLOATING FOUNDRY.

The foundry on the U. S. S. Vermont is described in the *Journal of the American Society of Naval Engineers* by W. B. Tardy, lieutenant, U. S. N., as follows:

In anticipation of the excessive amount of repair work that might be necessary on a cruise of the magnitude of that of the battleship fleet recently completed, and in view of the fact that the schedule called for two target practices distant from navy yards, it became necessary to improvise some means on board ship of making simple castings.

To this end a search for a suitable space developed the fact that about the only unused space was the exhaust hatch



PLAN VIEW OF FOUNDRY ON THE U. S. S. VERMONT, AND ARRANGEMENT OF FURNACE AND BLOWER

FORMULAS FOR FINDING THE WEIGHTS OF IRON CASTINGS.

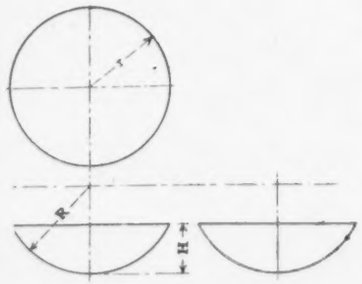
By W. L. and R. E. Tryon.

To find the weight of a spherical segment of one base, multiply the square of the height by the difference between the radius of the sphere and one-third of the height, by 0.818, or to the radius of the base squared, multiplied by the height by 0.409, add the height cubed multiplied by 0.136:

$$W = H^2\left(R - \frac{H}{3}\right) \times 0.818$$

or

$$W = r^2H \times 0.409 + H^3 \times 0.136.$$



W = Weight of casting in pounds.
R = Radius of sphere in inches.
H = Height of segment in inches.
r = Radius of base in inches.

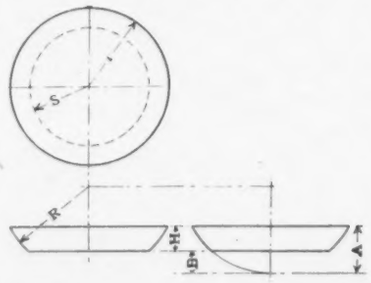
To find the weight of a spherical segment of two bases, from the radius of the sphere multiplied by the difference between the squares of the distances from the bases to the poles by 0.818, subtract the difference between the cubes of the distances from the bases to the pole, multiplied by 0.273, or

To the sum of the squares of the radii of the bases, multiplied by the height by 0.409, add the height cubed, multiplied by 0.136:

$$W = R\ (A^2 - B^2) \times 0.818 - (A^3 - B^3) \times 0.273,$$

or

$$W = H\ (r^2 + s^2) \times 0.409 + H^3 \times 0.136.$$



W = Weight of casting in pounds.
R = Radius of sphere in inches.
r = Radius of large base of segment in inches.
s = Radius of small base of segment in inches.
A = Distance from large base to pole in inches.
B = Distance from small base to pole in inches.
H = Height of segment in inches.

FORMULAS FOR FINDING THE WEIGHTS OF IRON CASTINGS.

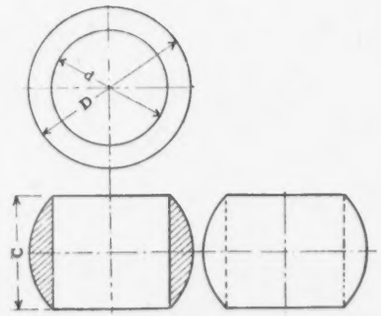
By W. L. and R. E. Tryon.

To find the weight of a ring made by cutting a cylindrical hole through the center of a sphere, multiply the chord cubed by 0.136:

$$W = C^3 \times 0.136.$$

The chord is equal to the square root of the result obtained by subtracting the square of the diameter of the hole from the square of the diameter of the sphere:

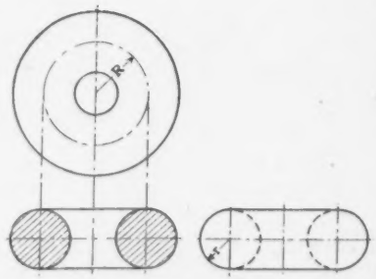
$$C = \sqrt{D^2 - d^2}$$



W = Weight of casting in pounds.
D = Diameter of sphere in inches.
d = Diameter of hole in inches.

To find the weight of a ring of circular cross-section, multiply the radius of the cross-section squared by the radius of the circle passing through the center of the cross-section by 5.140:

$$W = r^2\ R \times 5.140.$$



W = Weight of casting in pounds.
r = Radius of cross-section in inches.
R = Radius of circle passing through center of cross section in inches.

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

THE FOUNDRY DATA SHEET, DECEMBER, 1909.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication.

over Nos. 1 and 2 firerooms, dimensions of which are given in the accompanying illustration.

On examination of the material on board it appeared that everything needful for the installation of a melting furnace, except material for the smoke stack, is carried normally in engineering supplies.

Material Required.

While the ship was taking on ammunition at Tompkinsville in December, 1907, a steam launch was sent to the Brooklyn navy yard to get a 12-foot length of 6-inch iron sewer pipe. Immediately after sailing from Hampton Roads the blacksmith and a foreman, who by trade had been a molder, with two helpers, began the construction and installation of the furnace, sand box and work bench shown, which was complete in one week. The material required was as follows:

247 fire brick; 50 pounds Portland cement; 1 sheet steel plate, ⅛-inch thick, 36 x 72 inches; 32 feet, ¾-inch angle iron; 10 feet, 2-inch x ½-inch flat iron made into grate bars.

Sufficient asbestos mill board to cover stack and the 12-foot iron sewer pipe above referred to, which was installed for stack.

Lumber sufficient to make a work bench 30 inches x 8 feet, and a sand trough 6 feet long, 3 feet deep, 18 inches across the top, tapering to nothing at the bottom.

The experience during the cruise and since shows that the foundry may be successfully and efficiently run with the following outfit of tools and implements:

Two pairs ordinary lifting tongs; 2 shanks; 1 small shovel; 1 small slice bar; 1 small hand tongs (duck bill); 1 riddle; 1 trowel; 1 spoon slick; 1 small heel slick; 1 corner slick; 1 flange slick; 1 pipe slick; 2 lifters, 1¼-inch, 1½-inch; 1 pair small bellows; 1 crucible No. 50, capacity 175 pounds; 2 crucibles No. 80, capacity 240 pounds; 6 crucibles No. 20, capacity 60 pounds.

Melting.

Under normal conditions, making all kinds of castings needed for all departments of the ship, the following material is used: One ton Sandusky sand, one ton coke.

In addition to the coke a considerable quantity of lump coal is used mixed with the coke. The draft for the furnace is furnished by a ¼-horsepower electric blower, permanently installed, as shown in the accompanying illustration. This blower is one of those furnished to equipment navigation for double-bottom work and is loaned to the engineering department.

The incomplete records during the cruise show that, in addition to numerous small fittings cast and machined, the following more important castings were made for the various departments of the ship:

	Number.	Pounds.
For steam engineering.....	448	2,702
For construction and repair..	231	1,652
For equipment.....	49	210
For equipment navigation..	35	195
For ordnance.....	224	854

The Product.

In addition to this tabular list more than 50 2-inch Y's, 50 2-inch elbows, besides a number of tees for voice pipes, were cast and machined, fitted and installed. This was done at a total cost of $120, exclusive of the wages of the molders; all metal used being scrap, filings, borings, etc., that otherwise would have been thrown overboard.

Since the return of the fleet a dotter boom for each of the 12 turret guns has been made and installed by the ship's force, each boom requiring 12 cast fittings. This work would have been impossible in the time available but for the foundry.

Also, during the stay of the ship at Boston, two 33-inch, 600-pound gear wheels, together with driving pinions for both, have been cast and machined, and fitted in an effort to slow down the train of the after 12-inch turret.

Casting Gears.

With the facilities on board it was impossible to melt sufficient metal for this large piece of work, therefore the gears were designed as ribbed quadrants, and were cast in four pourings, and then the quadrants were machined and bolted together, after which the gears were cut and the wheels fitted.

The following list will show something of the nature of the castings:

Fittings for voice pipes, including Y's, mouth pieces, elbows and tees; deck sockets for stanchions; gear wheels of all sizes, for all purposes; extensions for sight drums; extensions for azimuth plates; valves and valve seats, and valve bodies; tees, elbows, couplings and fittings for all small pipe systems of the ship.

Due to the efficient working of this little foundry, it has been possible to renew all surface and bottom-blow pipes, without buying material or having any of the work done by the shore establishment.

Nearly two years' experience has shown that there is always sufficient scrap on board for all purposes of the foundry, and a careful examination of enlistment records of the engineer's force invariably shows one or more men in various ratings who are molders by trade.

SAND BURNT CASTINGS.

By W. J. Keep

Question:—We are experiencing considerable difficulty in producing smooth castings which are used as clock frames. Parts of the surface are filled with burnt sand, which the cleaning mill fails to remove.

Answer:—Your iron is poured entirely too hot. The sample casting which we have received is not of uniform thickness, being ⅜ inch thick in some parts and not more than 1/32 inch on the edges. To get the iron to these thin spots, the molder has cut his gate ⅛ inch thick and is obliged to pour his iron very hot. Make a new pattern of a uniform thickness of 1/12 inch and the edges should be at least ⅛ inch in thickness. Use a gate attached to the pattern, even with the parting edge, and not 1/32 inch below the surface as you have it now. Pour the iron into the mold as dull as possible, and the sand will not adhere. For light castings, the sand should never be mixed with the facing. It might be advisable to try one-half plumbago and one-half talc, which should be shaken from a bag, and it might also be advisable to print-back the pattern. The trouble, however, is in the pattern in this case, and if made the proper thickness, the weight of the casting will not be more than one-half of what it is at present. The iron which you are using, which is rather high in silicon, will give you a softer casting with a cleaner surface when the same is from 1/14 to 1/12 inch in thickness than if over 1/10 inch.

BRITISH FOUNDRYMEN'S ASSOCIATION.

"The Moral Factors of Foundry Efficiency" was the subject of the inaugural address delivered by R. Mason, the newly elected president of the Birmingham branch of the British Foundrymen's Association, at a meeting of this organization held at the Municipal Technical School, Birmingham, Saturday, Oct. 23. He directed attention to the necessity of welfare work among foundry employees, and cited a number of large English firms that have installed shower baths, wash rooms, etc., for their molders. On Monday, Oct. 25, the members of the Birmingham society paid a visit to the foundry of Jones & Attwood, Stourbridge.

CASTING CANNON IN REIGN OF LOUIS XV

French foundry practice in the eighteenth century including coremaking, molding, melting the metal and casting

BY JOSEPH S. HORNER

THE legend that there is nothing new under the sun is only a half truth in Occidental lands. But the veracious moiety is rich in interesting facts. The museums teem with illustrations of the one touch of nature that links us to prehistoric man. And the study of early industries and manufactures is a mine that will take a vast deal more working than it has yet received.

A work of rich interest to the student is the great French Encyclopedia of Diderot and D'Alembert, the first volume of which was published in 1751. The fourth volume of plates, date 1777, shows examples of founding of the period. From these illustrations a selection is here given, showing how the cannons of Louis XV were molded and cast, before the faintest rumblings of the approaching great revolution had begun to disturb the elegant and selfish lives of the old regime. It is curious to think how the Bourbon kings must have read these volumes, and gazed with interest on these plates when it was the book of the period, discussed in the salons of the *grande dames* which were the centers of the intellectual activities of the period. The descriptions are as accurate as the plates, inclining to prolixity. One, Bernard, was the engraver, and the plates are as fresh as when they were issued in Paris in 1777 by Briasson, David, and Le Breton, graciously permitted and approved by *Le Roi*. In the plates selected, the illustrations are those of work in the foundries in which were cast the cannons or *ordinnance du Roi* Louis Auguste De Bourbon, Duc du Maine. They included both cannons and mortars with their shot or *boulets*. The translation given is free, retaining the sense rather than the original construction.

Making the Core.

The first illustration from plate XI, Fig. 1, will be readily recognized as the essential work of laying bands around a core bar of octagonal form. Rather a slow job, turning it with a cross handle slipped over the end instead of a winch. The bands are of plaited or twisted straw, being wound around the bar which the writer curiously terms a *trousseau*. It is the first stage in the formation of a loam pattern, from which to make the mold of dried

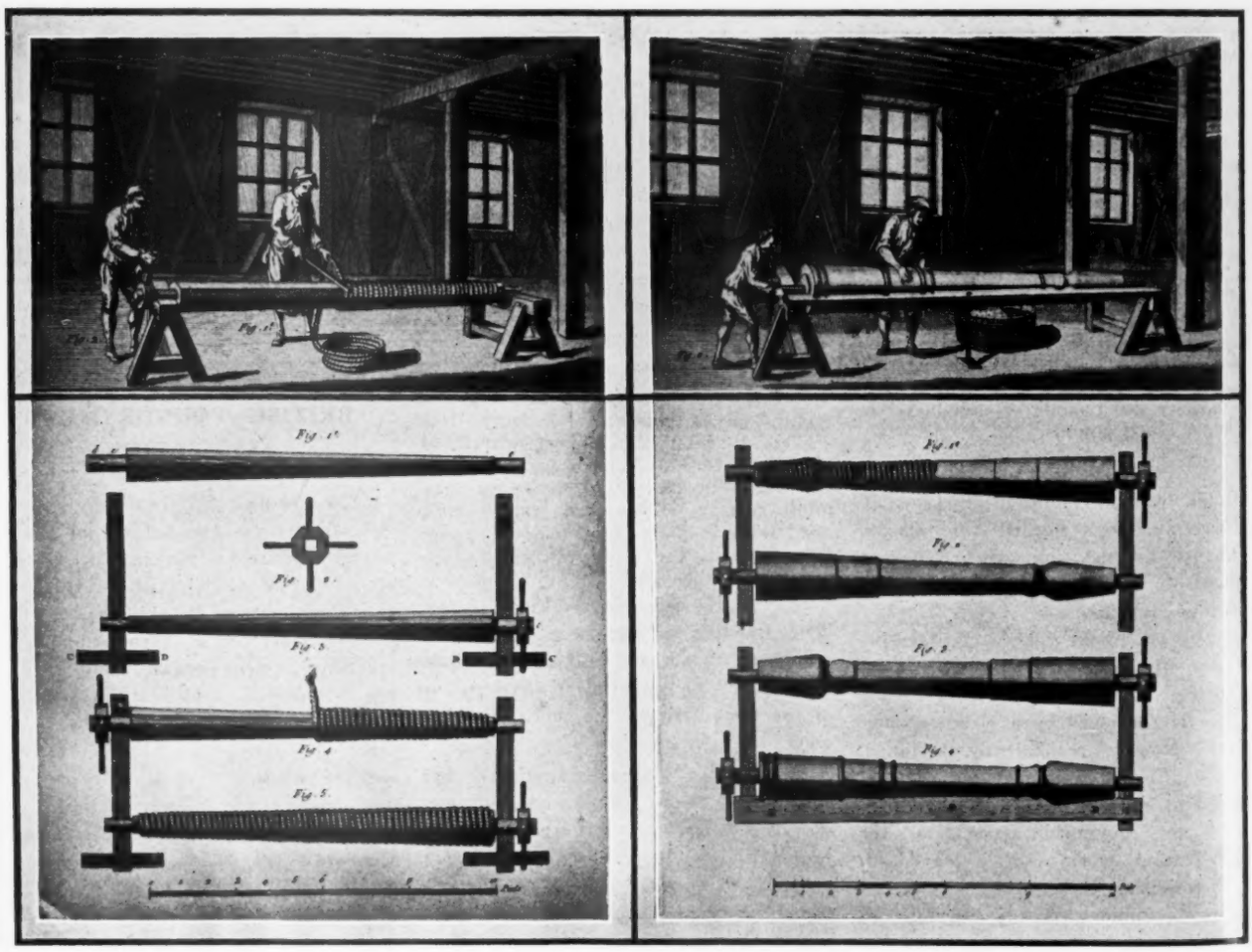


FIG. 1—MAKING CANNON CORES. THE ARBOR IS WOUND WITH STRAW ROPE

FIG. 2—APPLYING THE LOAM TO THE BANDS OF STRAW ROPE

sand or loam. The bar is supported on three-legged wooden horses, having notches in which the round ends of the bar revolve. The workman, *Fig. 1*, grips the band of straw from the coil close by on the floor, and strikes it with a bar as he winds. The first end of the band is attached to the end of the core bar with two nails. The workman, *Fig. 2*, in the illustration, is turning the large end of the bar with the cross, small windlass, or small mill—*moulinet*—as the cord of straw is applied.

In the lower part of this illustration, the size of the piece which has to be made for the mold.

Applying the Loam.

In plate XII, Fig. 2, the workman, *Fig. 1*, applies with his hands the loam or earth (*terre*) on the straw bands, which cover the bar, and which is warmed slightly to enable it to adhere. The first beddings or layers are made of heavy or rich earth, diluted and mixed with powdered brick. The last layers are composed of loam well ground and mixed with hair and horse manure. A pattern (loam board) is with bands, and one-half the length covered with the first layer of loam; *Fig. 2* shows the same entirely covered with the first layer; *Fig. 3* the same covered with the second coat; *Fig. 4* illustrates the core after the last layer has been put on, ornamented with moldings formed by the board.

Ornaments and Other Parts of the Cannon.

In plate XIII, Fig. 3, we see pattern-makers at work fitting parts to the loam pattern just as their descendants do to-day. The workman, *Fig. 1*, is attach-

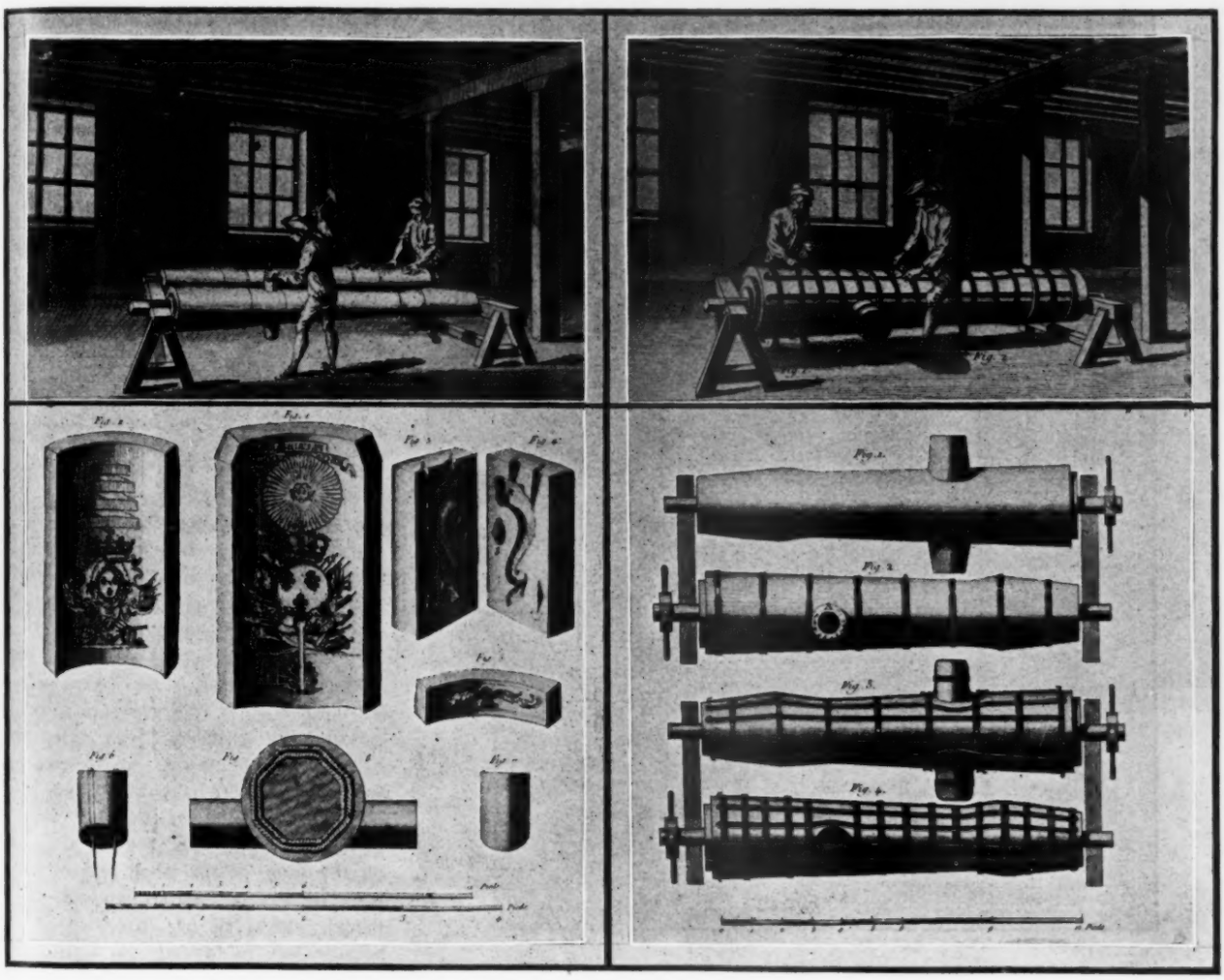


FIG. 3—PATTERNMAKERS FITTING LOOSE PIECES TO CANNON PATTERN

FIG. 4—FORMATION OF THE COPE AROUND THE COMBINATION PATTERN

Fig. 1 is the bar or *trousseau*, *Fig. 2* the four-armed cross, *Fig. 3* the bar on its little wooden horses, *Fig. 4* the same with a moiety of its length wound. It is also greased with axle grease. *Fig. 5* shows the same completely covered. The statement is made that it might be covered with one or more revolutions of the twisted straw until it approaches cut, following the profile of the piece, and so removes superfluous portions. The loam is seen in a tub alongside the workman. The pattern board is seen in front resting by its ends on the wooden horses, and supported in the middle by a prop to oppose the bending of the board there. The illustrations below show the bar, *Fig. 1*, covered ing the trunnion patterns, made in wood, to the loam body. He is nailing them on. At the end, the workman *Fig 2*, is attaching the ornaments, the two handles, and other devices. These are formed first in wax softened in turpentine, assembled, and reproduced in molds of plaster, from which wax models are subsequently taken. The molds are

shown separately in the lower part of the plate. *Fig. 1* is a plaster mold for the ornaments at the breech end of the gun. *Fig. 2* shows the plaster mold for the ornamentation immediately in front of the trunnions. *Figs. 3* and *4* show a core box for the horns of the cannon made in the form of dolphins. The halves are fitted with dowells *b* and *d* *Fig. 4*, fitting in their holes *a* and *c*, *Fig. 3*. The wax is poured in at the funnels or shoots (in-gates) at *I*, *I*, until the mold is full. The other openings *2 2*, give issue to the air contained in the mold, out of which, when the mold is full, the air issues with force. *Fig. 5* shows the mold for other ornaments, several of which were disposed about different parts of the cannon in those days. *Fig. 6* is one of the pattern trunnions as it would appear from the top of the cannon. The writer points out that one end is cut square, the other oblique to fit to the body, and also calls attention to the two nails which serve to fix the trunnion on the model. *Fig. 7* is a view of the other side (how very precise they were) and *Fig. 8* is a section through the model showing the trunnions attached to it, and the octagonal or bar *trousseau*, the bands, and the enclosing loam.

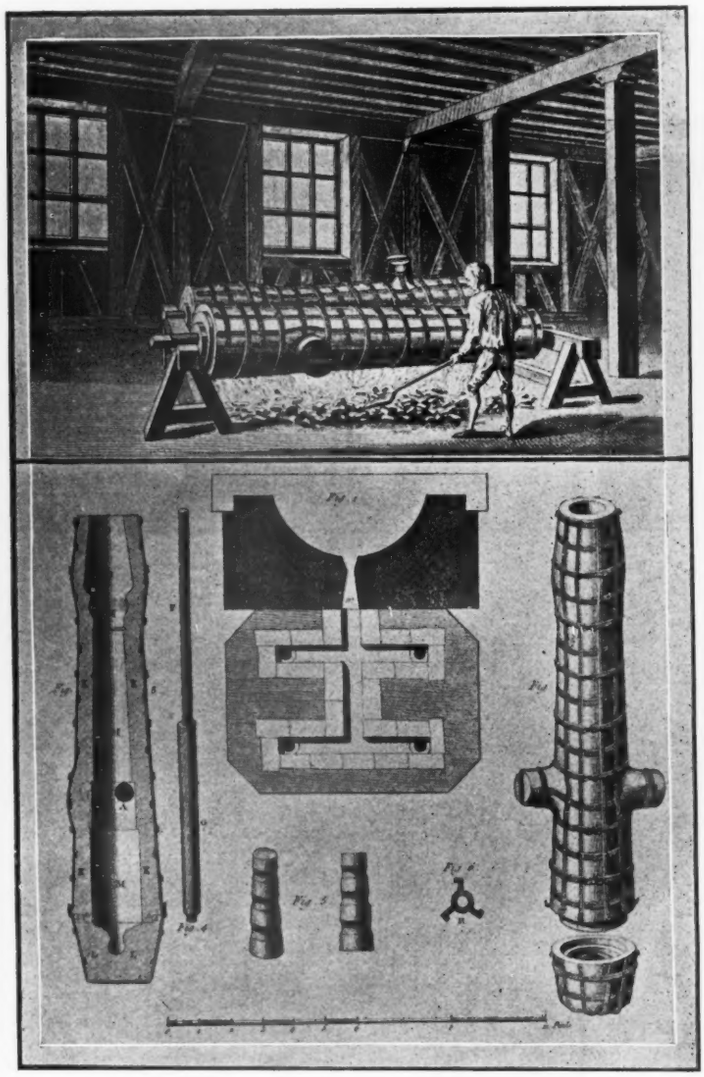


FIG. 5—DRYING THE MOLD, A SECTIONAL VIEW OF WHICH IS SHOWN IN THE LOWER PART OF THIS ILLUSTRATION

Making the Cope.

Plate XIV Fig. 4, represents the formation of the cope (*chape*) or actual mold around the composite pattern of loam, wood, and wax. The model fitted with its trunnions, handles, and ornaments is smeared all over with a composition of tallow and oil to prevent the loam of the cope or mold from adhering, and to facilitate subsequent parting. This mold is commenced by laying several thicknesses of "fat" loam prepared with hair and horse manure, and passed through a sieve. These first layers, called the *chemise*, are dried. These are then covered with layers of stronger, coarser loam until the required thickness is made up.

In order to afford adequate support for this against the pressure of casting, bonds of iron are next fitted, both circularly and longitudinally. They are terminated with hooks, which receive iron wires with which union of the ends is made. This is the operation, which is shown in the upper part of plate XIV, Fig. 4.

The trunnion pattern parts are drawn out, and the openings by which they are drawn are covered with cakes of dried loam, luted with the same composition and fastened by the longitudinal bands bent to enclose them.

The Finished Mold.

In the lower part of this plate, *Fig. 1*, is the mold as it appears finished. *Fig. 2* is the same fitted with the circular belts. At *A* is seen the hole through which a trunnion pattern has been withdrawn, and which has to be covered with loam cake as previously mentioned. In *Fig. 3* the same mold is shown fitted with the longitudinal bands. *Fig. 4* is the last stage in which a second set of circular bands are tightened on the longitudinal bands. All the intermediate parts are finally filled up with strong loam.

Drying the Molds.

Plate XV, Fig. 5, represents the operation of drying the molds, which is repeated for each layer, both for the model and for the cope. Rather a wasteful method of drying, though one often sees the same method adopted for skin-drying a coat of black wash. Apparently, drying stoves were not in existence in these pre-revolution times.

After the mold has been dried it is lifted from the horses or trestles, and the nails which hold the straw ropes at the small end of the bar are detached, and several blows are dealt on the same at the small end to loosen it. The bar is then drawn out of the model, which, we are informed, is easy because of its pyramidal form. The bar carries with it one end of the rope, which comes out with facility. In this state, the mold, with the model it contains, is carried into a *fosse*, shown in *Fig. 1* at the lower part of the plate, at the front of a furnace on some cross bars termed the *chaise*. A wood fire is built which has the effect of melting away the grease with which the model was covered, and so separates the model from the mold, as well as the wax portions of the model which formed the handles and ornaments. These separate, and the loam of the model, drying, becomes fragile, which facilitates its

removal, leaving the interior of the mold the counterpart of the model.

Molding the Breech.

While these operations are going on, attention has been given to making the portion of the mold for the breech end, and uniting it to the body of the mold. In the lower part of the illustration, *Fig. 1*, is a plan of part of the furnace and above, the *fosse* or hole in which the molds are placed and buried. On this, sand is well beaten (rammed) and a gutter (runner) constructed with its branches to join with the opening *m*, for the flow of metal, and the other branches with their openings of the molds. *Fig. 2* shows the complete mold dried and under it the breech portions slightly separated. Attention is directed to the cheek by which the two parts are fitted exactly and luted, as well as to the hooks on the longitudinal bands of the mold and the corresponding hooks on the breech piece, to be united with wire, as explained previously in connection with the bands of the main body.

Fig. 3 in this plate is a section through the mold on its longitudinal axis, and perpendicular to the length of the trunnions. The thickness of loam which comprises the mold is indicated by *K K*. *L L* is the mold of the breech piece, luted and bound to the main body; *M M M*, it is pointed out, is the space which the metal fills to form the massive cannon. The part *O O* is interesting, showing the amount of head metal employed. It is said to take precedent or to fill before the mass of the metal is filled, and forms a piece, which cooling, diminishes in volume, or as we should term it, a shrink-head.

Fig. 4 is the core, and we are informed that it is the ancient manner practiced in founding fallen into disuse for ordnance, but brought back here. What the ancient manner is is not stated, but perhaps casting solidly. The core is composed of one cylindrical bar surrounded with iron wire, clothed with earth and luting loam. Part of the bar uncovered is shown at *F* and *G* is the part of the same bar covered with the preparation in loam.

Fig. 5 is a mass of pure copper in which the touch hole is pierced, and drawn to a scale four times larger than the other parts. It is put in place in the mold at a proper distance from the entry. *Fig. 6* is a chaplet which serves to sustain the core when the metal is being poured.

Melting the Metal.

In plate XVI, Fig. 6, *Fig. 1* is the master founder, who, with a bar, is opening the furnace, removing an iron plug which closes the interior of the furnace within which is the bath of metal. *Fig. 2 is* a workman who pulls down the *basculé* or lever bar which lifts the iron door of the furnace, to permit the other workmen to get at the interior with their rabbles. *Fig. 3* shows the workman with a rabble of iron, which is crooked at the end, skimming the slag from the metal and drawing the scurf on to the hearth in front of the door. He does the same service on the side opposite. *Fig. 4* is the workman, who looking into the furnace, gives instructions to the previous one. Note how he shades the heat from his head with his hat. *Fig. 5* is a workman who holds a small distaff at the opening of one of the molds—a riser. He will do the same for another mold when full. The distaff is a clay plug on the end of an iron rod, and is so shown separately in another drawing not included here. *Fig. 6* shows supervising officers present at the casting of the king's cannon. There is also shown, but not reproduced here, a combined file and saw for severing the head metal, and the casting as it appears with this head still intact, is likewise illustrated.

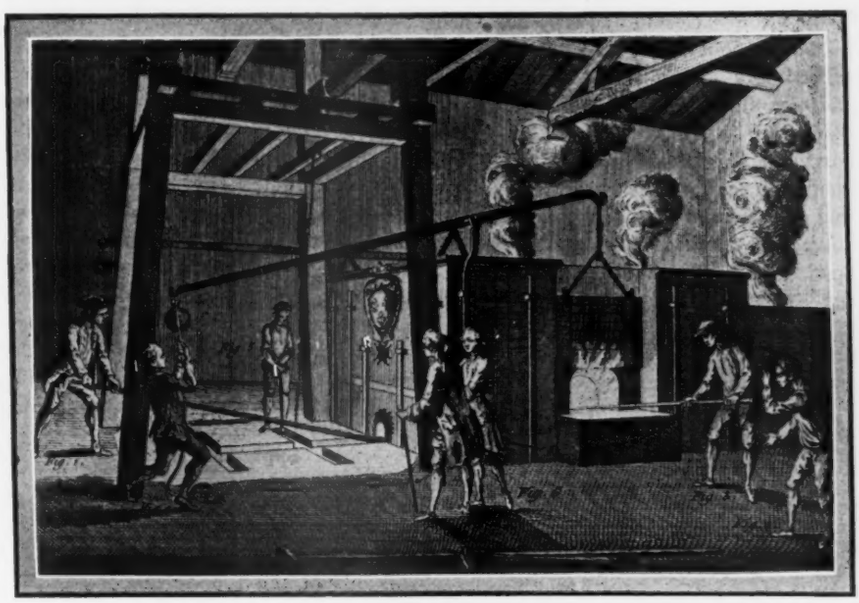


FIG. 6—THE FURNACE IN WHICH THE IRON WAS MELTED

ANNUAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

The thirtieth annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies building, New York City, Dec. 7 to 10. The entire social entertainment will be in charge of the members resident in and about New York. An excursion is planned for Wednesday afternoon, Dec. 8, which members and guests will be asked to attend in a body, and during the balance of the time there will be opportunities for small parties to visit places of interest. In the evening there will be a lecture upon the subject of agricultural machinery. The following professional papers will be presented:

"Tests on a Venturi Meter for Boiler Feed," by Chas. M. Allen.
"The Pitot Tube as a Steam Meter," by Geo. F. Gebhardt.
"Efficiency Tests of Steam Nozzles," by F. H. Sibley and T. S. Kemble.
"An Electric Gas Meter," by C. C. Thomas.
"Tan Bark as a Boiler Fuel," by David M. Myers.
"Cooling Towers for Steam and Gas Power Plants," by J. R. Bibbins.
"Some Studies in Rolling Mill Engines," by W. P. Caine.
"An Experience with Leaky Vertical Fire Tube Boilers and the Best Form of Longitudinal Joint for Boilers," by F. W. Dean.
"Testing Suction Gas Producers with a Koerting Ejector," by C. M. Harland and A. P. Kratz.
"Bituminous Gas Producer," by J. R. Bibbins.
"The Bucyrus Locomotive Pile Driver," by Walter Forris.
"Line-Shaft Efficiency, Mechanical and Economic," by Henry Hess.
"Pump Valves and Valve Areas and a Report on Cast Iron Test Bars," by A. F. Nagle.

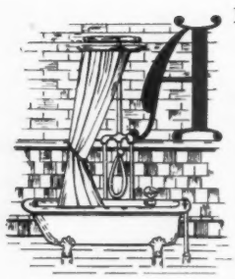
In addition several valuable reports will be submitted by committees of the gas power section.

The B. F. Sturtevant Co., fan, blower and engine manufacturer, has established in its works at Hyde Park, Mass., a branch of the Massachusetts Savings Bank Insurance. The work is in charge of an instructor who goes among the men explaining the necessity and value of systematic saving. A large number of the members and employes of this concern have taken advantage of this proposition, and have taken insurance in amounts varying from $500 to $1,000.

ENAMELED CAST IRON SANITARY WARE-VII

Description of the closet bowl molding machine, method of making the closet ring, and the time in detail, for the various foundry operations

BY DILLEN UNDERHILL



ALTHOUGH the closet tank, described in THE FOUNDRY, November, 1909, has met with popular favor and is made in large quantities by all of the manufacturers of sanitary ware, the enameled iron closet bowl has had a hard fight for existence. It is exceedingly difficult to manufacture, and for this reason it cannot compete readily in price with so-called, solid porcelain bowls. Furthermore, the manufacturers of the latter line insist that the enamel does not find its way down the tortuous passage below the bowl, and undoubtedly, for this reason, there are many bath rooms fitted throughout with enameled ware, with the exception of the closet bowl, which is porcelain.

While it is true that it is impossible to see whether the passage referred to is thoroughly enameled, it has been proven by breaking open many of these closets, that an experienced enameler covers this surface as well as could be desired. Plan view and side elevation of the bowl are shown in Fig. 1, and in Fig. 2 is illustrated the closet ring. A wood match or follow-board is made for the bowl, and on this is built-up a lead pattern similar to the one used in the production of bath tubs. All irregular curves and sharp corners, that do not readily permit the sheet lead to fit snugly against the match, are formed in wood, and from these, white metal loose pieces are made and secured in place. From the lead pattern is first made the drag pattern plate shown mounted in Fig. 3, and the cope pattern is similar to this, with the exception that it is the opposite hand. To the lead pattern are added the core prints *A B*, Fig. 3, as well as four bosses underneath the pattern plate near the four corners, so that the pattern can be screwed securely to the plate on which it is mounted.

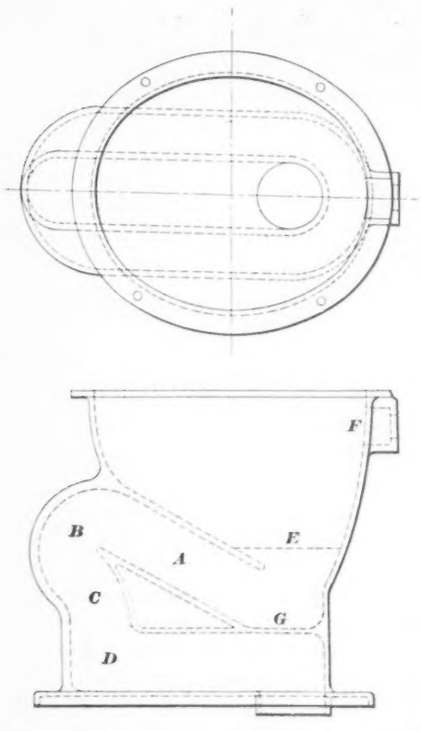


FIG. 1—PLAN AND SIDE ELEVATION OF CLOSET BOWL

Syphonic Action.

All bowls are provided with some form of syphon connection for producing a suction to draw all of the soil out of the top of the bowl. The cross-section of the syphon must be about 3 inches in diameter, or its equal in area, and approach a circle, yet a simple syphon will not work as well as one in which the passage is somewhat tortuous or deflected. The reason for this is that the water entering under low pressure through the 1½-inch opening will flow through the bowl and produce no syphonic action whatever. In the bowl shown in Fig. 1, the water flows down the sides and into the passage *A*. At the bend *B*, it dashes across and strikes the side and bounds back and forth as it is driven out of its course at *C* and *D*. The first effect is to reduce the flow of the water and produce eddies. This causes the water to fill all the 3-inch openings and acts as a solid plunger until it passes out into the soil pipe. This produces a vacuum, and the air and water clean out the bowl. The second effect is what is known as the "after fill," *i. e.*, when the closet tank is nearly empty the remaining water must not be syphoned out, but as much water as the bowl will hold up to level *E* should be left to catch the soil. Being thus retarded, the remaining water will form only a spray and the syphonic action is broken at the proper time. A syphon jet closet is also on the market, which has an auxiliary core opening running direct from the inlet *F* to the point *G*. This is believed to help the "after fill" and syphonic action.

Closet Ring.

The closet ring, shown in Fig. 2, rests on top of the bowl and is held in place by machine screws, which are passed through the bottom of the top flange through the four small holes shown in Fig. 1. In the closet ring, openings are tapped in the corresponding bosses. The ring sets away from the bowl about 1/32-inch at its edge *H*, Fig. 2, thus permitting the water entering at *F* to strike against the lip, follow around the ring and distribute itself in a thin sheet around the bowl.

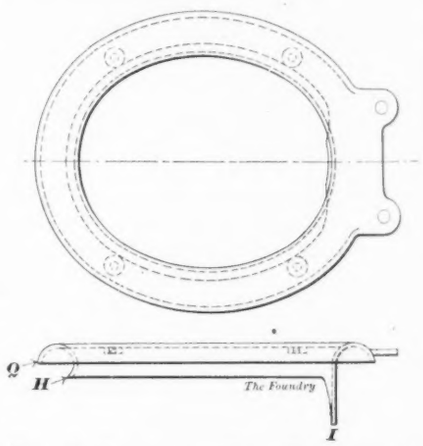


FIG. 2—PLAN AND SIDE ELEVATION OF CLOSET RING

Some closets are so designed that this ring is made solid with the bowl, and perforated openings are made into the angular space to accomplish the same results. This angular space is cored out with a dry sand core, whereas the bowl, that will be described, is made entirely with green sand. Various other designs are in

use, but the principal features of this pattern have been retained. Connection is made to the water inlet by inserting a bushing with three projecting lugs, which pass through suitable notches. This bushing, after being inserted, is turned slightly and the lugs engage against the bowl inlet flanges. A rubber gasket is slipped over the bushing, a nut is screwed up tight, and to these, connections are made to the high or low-down closet tank.

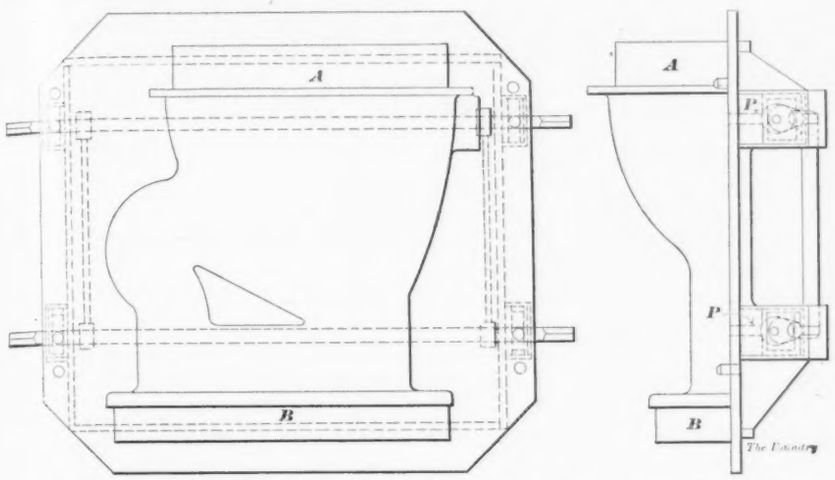


FIG. 3—PLAN AND SIDE ELEVATION OF CLOSET BOWL PATTERN ON DRAG MACHINE

It is especially desirable, when producing enameled ware, to have a surface formed by green sand to which to apply the enamel. A dry sand core always leaves a rougher surface than that produced by green sand, and when the enamel is applied, this rough surface is still further accentuated. The core for the bowl presents a difficult problem to the foundryman, as it is of such irregular form, and its tendency to rise in the mold is even more marked than if it extended in a straight line throughout its entire length. Dry sand cores are sometimes used for bends, similar to the one in this bowl, in soil pipe traps, but only for such special work for which it will not pay to make up a cast iron arbor.

Green Sand Core Machine.

A plan view of the green sand core machine is shown in Fig. 4. It consists mainly of two core boxes, which have been made from the lead half patterns. The lead pattern has been altered by the addition of the lugs *A A*, by which the core boxes are attached to the handles by means of screws. The cylindrical section *C*, has been lengthened so that the core can extend beyond the bottom of the casting. Flanges are also added so that a flat plate can be fastened in position to stop-off the sand. At the bowl end *E*, the flanges are set in at the bottom so that the plate stops-off the sand at an angle. The handles *B B*, Fig. 5, form a kind of cradle for the core boxes and are hinged at the end at *F*. A cast iron stand *G* is located between the handles and is

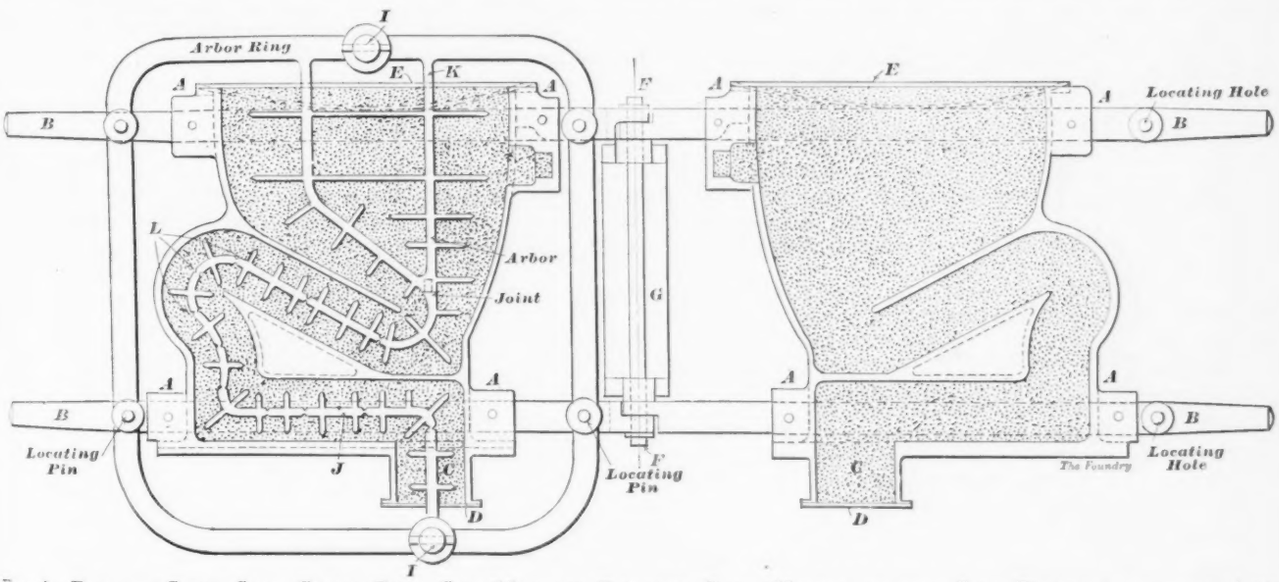


FIG. 4—PLAN OF GREEN SAND CLOSET BOWL CORE MACHINE SHOWING BOTH HALVES OF THE CORE RAMMED, AND THE ARBOR RING IN PLACE BEFORE CLOSING

either attached to the floor or to a plate extending at least as far as the lugs *H H* on the handles. The arbor ring is shown at *B B*, Fig. 4. This is made of cast iron, being rectangular in section, ½ x 1½ inches in size,

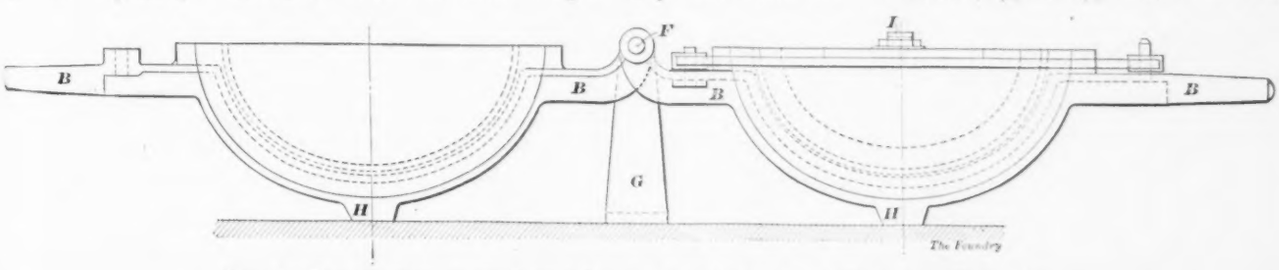


FIG. 5—END ELEVATION OF CLOSET BOWL CORE MACHINE IN RAMMING POSITION

and has cast bosses for the locating pins, which are bolted in place, the holes all being drilled to a template. At *I I*, Figs. 4 and 5, is a round boss,

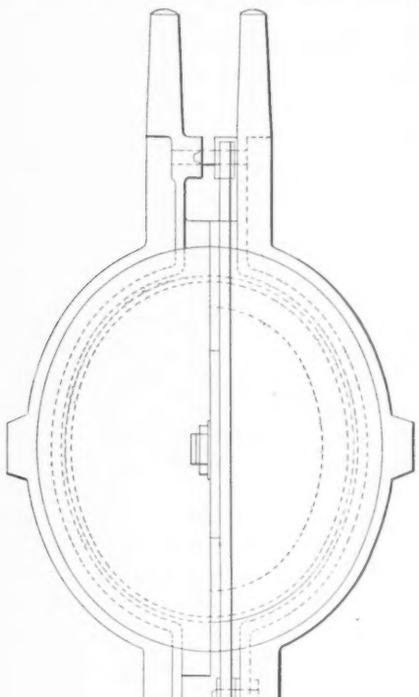


FIG. 6—CORE MACHINE CLOSED

cast with a horizontal, slotted opening. This boss is cast on the arbor ring and to it is attached the arbor, which drops over the boss and is held securely with a wedge, a cut nail serving this purpose.

The Core Arbor.

The arbor is made to conform to the shape of the bowl. It is usually cast in two pieces, and the rougher it is made the better the sand will adhere to it. The two pieces are joined at the lower end of the bowl, the section *J* being cast with a dowel having an indentation. The section *K* is cast, as it were, with a mortise, with side openings into this mortise. When these two parts are placed together, a wedge driven through the side opening and into the indentation securely binds the two. It will be noted that the arbor *J*, is cut nearly in two at various points, as at *L*. This is done so that the cast iron arbor can be readily broken into small pieces and leave the casting with the core sand. Section *K* of the arbor is saved and is used over and over again.

Making the Core Box.

When making this core box, the two halves are matched by placing them together, one on top of the other, and filing them until their edges are flush with each other. Filing the inside is somewhat of a fit-and-try job, but if the lead pattern has been carefully handled, the core box should require only a small amount of work to obtain the proper thickness for the final casting. When mounting the patterns, the core box holding the arbor is set in place to conform to the arbor ring, and is held in position with screws. The other half core box is placed on top of this and is shifted until it matches at the joints. The handles *B B*, are brought down on top of the core box, clamped to it, drilled and tapped, and screws are fastened to hold them together. The hinges, when new, insure the matching of the core boxes, but as an additional safeguard, the outside locating pins are made of sufficient length to engage in the two locating holes in the other handles. It will be noted that the arbor and arbor ring all lie below the parting line in half of the core box, Fig. 5. This is what may be termed the drag half of the core and supports the hanging sand while the other, or cope half, rests on top of the arbor after it has been turned over.

Making the Core.

When the core boxes have been properly adjusted for thickness, parting, etc., the operation of making the

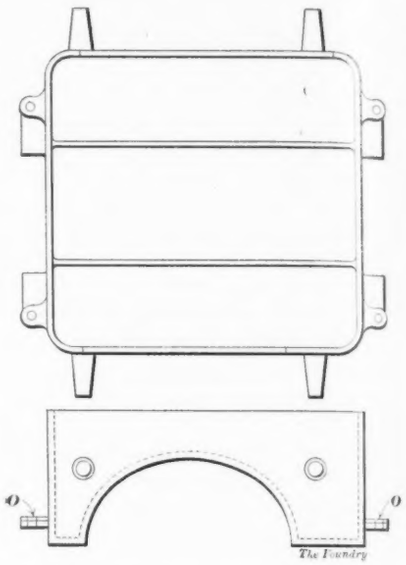


FIG. 8—PLAN AND END ELEVATION OF DRAG CLOSET BOWL FLASK

core is as follows: The arbors *K* and *J* are fitted together, placed on the arbor ring, and are keyed or nailed in position. The ring and arbor are next set on the core machine and are pushed down over the locating

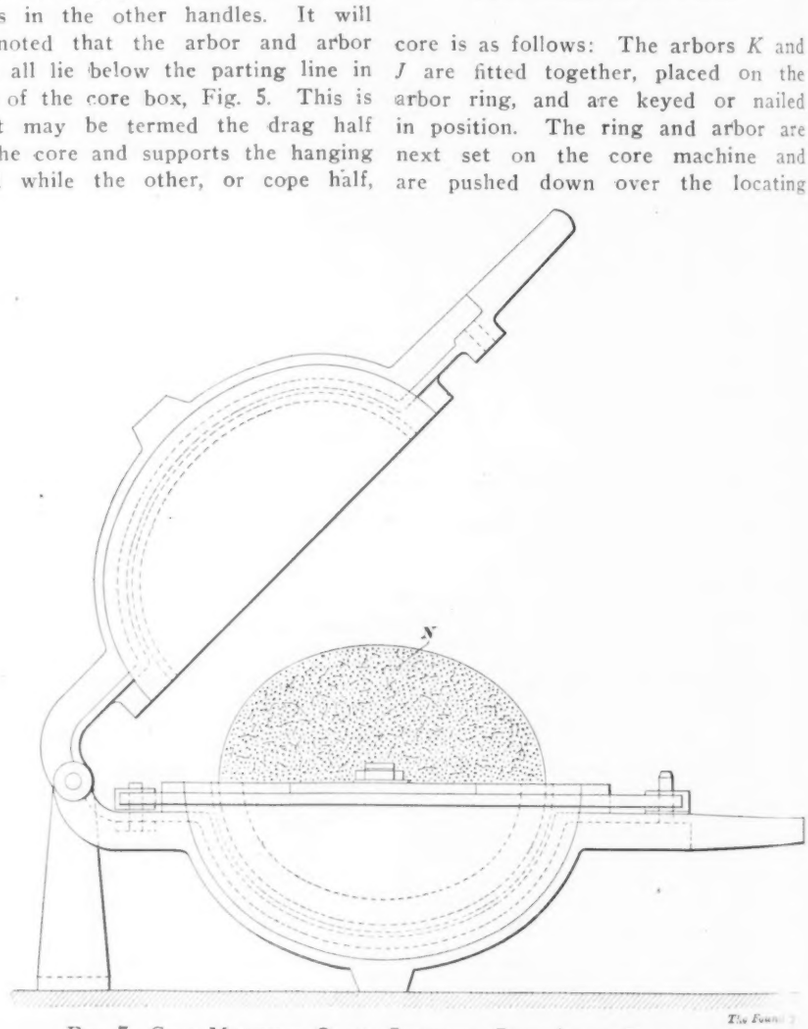


FIG. 7—CORE MACHINE OPEN, SHOWING CORE AFTER RAMMING

pins. The core machine, at this stage of the operation, is open, as shown in Fig. 4. Sand is then riddled into the core boxes and is tucked and rammed against the surface of the boxes and between the projections on

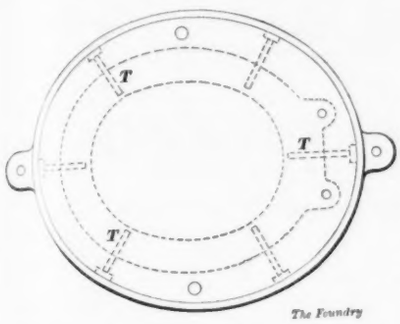


FIG. 9—PLAN VIEW OF CLOSET RING FLASK

the arbor. The remainder of the sand is then shoveled into the boxes and rammed in place. As the parting lines of each half of the core box lie in level planes, the surplus sand can be struck off with a flat iron bar. All loose sand is blown off gently with a bellows and a vent is cut in the cope core corresponding almost exactly to the main section of the arbor. This vent extends from one end of the mold to the other, as this green sand core extends from one end of the flask to the other. Flour paste is sometimes added to stick the two halves of the core together. After striking-off, the two halves of the core are closed by two molders, one grasping each handle of the machine, which assumes the vertical position shown in Fig. 6. The machine is closed and is then lowered to one side, the half containing the arbor being underneath. As soon as the stop *H* rests upon the floor or plate, the core box is rapped with a mallet to loosen the core. The top half of the core machine is then raised, as shown in Fig. 7, leaving the cope core *N* resting on the drag core. The half of the core machine which is now uppermost is then opened out until it assumes the position shown in Fig. 5. The arbor ring is next lifted off, the mold and arbor coming with it, and a molder patches up the small defects by holding the arbor ring in his lap or rests it on convenient supports.

Cope and Drag Machines.

The cope and drag machines differ in only a few minor details. The patterns are right and left hand, and the lifting eccentrics are larger on the drag machine than on the cope machine. The reason for this can be readily understood by reference to Fig. 8, which shows the drag flask. The lifting and locating ears *O O*, are set up from the parting line to provide clearance for the arbor ring when the flasks are closed together. Therefore, the lifting pins *P P*, Fig. 3, must be extended to meet these lugs and also lift the drag mold away sufficiently to free the sand from the patterns. On the cope flask, the lugs *O O*, may be flush with the parting line, and the throw of the lifting pins is not so great. In Fig. 8, one end of the drag flask is shown open, which is also true of the other end, thereby providing a space for the core to extend through.

TIME REQUIRED FOR MAKING GREEN SAND CORE FOR CLOSET BOWLS.

Two operators.	Time of each operation. First operator. Min.	Sec.	Second operator. Min.	Sec.	Elapsed Time. Min.	Sec.
2 men lift core box		15		15		15
1 man cleans core box 1 man sifts sand		25		25		40
1 man blows off excess sand 1 man patches		22			1	02
1 man applies paste 1 man patches		32			1	34
1 man sets arbor 1 man patches		12			1	46
1 man sifts sand 1 man patches		31			2	17
1 man rams 1 man patches	1	32			3	49
1 man sifts sand 1 man patches		15			4	04
1 man rams 1 man patches	1	18			5	22
1 man shovels sand 1 man patches		14	4	56	5	36
2 men ram		38		38	6	14
2 men strike-off		24		24	6	38
2 men brush off mold		27		27	7	05
1 man blows off sand 1 man waiting		17			7	22
1 man cuts vent 1 man waiting		59			8	21
1 man puts sand in vent 1 man waiting		27			8	48
1 man applies paste 1 man waiting		11	1	54	8	59
2 men close machine		3		3	9	02
1 man raps 1 man waiting		15			9	17
1 man opens machine 1 man waiting		15			9	32
2 men lift out cores		12		12	9	44

Time required for making green sand core, 9 minutes and 44 seconds.

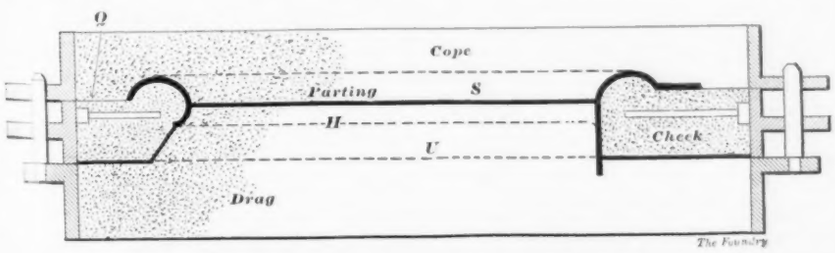


FIG. 10—SECTIONAL VIEW OF CLOSET RING MOLD

Dry Sand Core.

The core print *B*, Fig. 3, is provided for a dry sand core (not shown), which hollows out the bottom of the bowl and also cores the holes for attaching it to floor. This core is made in halves, one-half being set in the drag before the green sand core is in place. Loose locating pins are placed

in the drag mold, and the arbor ring and the green sand core are carefully set in place. The cope half of the base dry sand core is set in position and the cope is closed down. After ascertaining whether the green sand core fits properly, both in the cope and drag, the mold is finished and ready to pour. The metal enters the mold from the sides on a line with the parting.

Molding the Ring.

In Fig. 2 is shown a type of ring that is used to divert the water in a thin sheet to encircle the bowl. This casting is made entirely in green sand. The flask is in three parts, as shown in plan in Fig. 9, and in section in Fig. 10, the casting being molded right side up. The parting for the cope and cheek is on a line with the outside of the ring at *Q*, and the parting for the cheek and drag is somewhat lower than the bottom roll at *H*. No special machine is used for stripping, as the mold is light and individual match plates are used. For the cope, a plate is cast provided with locating holes and a cavity conforming to the upper surface of the rim. On this is placed the cope flask, which is elliptical in form and is rammed and lifted away by hand. The machine for molding the core or the cheek of this mold is made in two parts, parting on the line *Q* at the outer edge of the rim. The plate on the cope side contains the flask locating holes, and on this plate, locked with dowels, is set a cover or lid, which conforms to the required curve. The cheek is elliptical in form, and is provided with a number of projecting, round wrought iron bars, *T*, cast in place so as to reach out into the cavity of the mold and support the core sand. After the cheek has been rammed, the cover half of the machine is removed and the mold is lifted away. The cope parts in the center down to the line *S*, and follows along the pattern to the line *U*. The drag is molded on a plate similar to the cope, and when rammed is lifted away. These match-plates are not shown, as they are simple in construction, and a molder, of only ordinary ability, can easily become familiar with this operation.

Time Required for Various Operations.

The efficiency of molders on this line of work was easily arrived at by obtaining the time required for each operation. The men were timed with a stop watch, and notes were carefully made so as to insure the accuracy of the record. The time

TIME REQUIRED FOR SHAKING-OUT CLOSET BOWL CASTING.

One operator.	Time of each operation. Min.	Sec.	Elapsed time. Min.	Sec.
Raps		20		20
Shakes-out		13		33
Carries back cope flask		11		44
Throws out bottom cores		41	1	25
Lifts out casting		10	1	35
Raps, knocks out sand in bowl, and takes bowl from arbor	1	17	2	52
Carries away frame		25	3	17
Carries out closet	1	20	4	37
Carries water to cool and temper sand	1	35	6	12
Strikes and shakes out drag		23	6	35
Dumps remaining sand from drag flask		27	7	02
Carries back drag flask		10	7	12
Sets up bumping block		10	7	22

Time required for shaking out closet bowl, 7 minutes and 22 seconds.

TIME REQUIRED FOR MAKING DRAG MOLD ON CLOSET BOWL MACHINE.

One operator.	Time of each operation. Min.	Sec.	Elapsed time. Min.	Sec.
Cleans pattern	1	01	1	01
Sifts parting sand		11	1	12
Carrying drag flask		36	1	48
Securing nails		42	2	30
Shakes and levels flask		19	2	49
Sifts sand		40	3	29
Shovels		46	4	15
Rams		48	5	03
Shovels		46	5	49
Rams		26	6	15
Strikes off and sifts on sand		30	6	45
Puts on bottom board		20	7	05
Raps		25	7	30
Takes off mold		15	7	45
Turns mold over		30	8	15

Time required for making drag half of closet bowl mold, 8 minutes and 15 seconds.

TIME REQUIRED FOR MAKING COPE HALF OF MOLD ON CLOSET BOWL MACHINE.

One operator, average time ..... 10 minutes.

TIME REQUIRED FOR FITTING ARBOR FOR CLOSET BOWL.

One operator, average time ..... 2 minutes, 56 seconds.

TIME REQUIRED FOR MAKING DRAG CLOSET RING MOLD ON MACHINE.

One operator.	Time of each operation. Min.	Sec.	Elapsed time. Min.	Sec.
Cleans and brushes off sand		24		24
Puts on drag flask		06		30
Sifts sand		16		46
Tucks		08		54
Shovels		13	1	07
Rams		36	1	43
Strikes off		11	1	54
Raps		20	2	14
Takes off drag flask		26	2	40
Shakes sand off pattern		40	3	20

Time required for making drag half of closet ring mold, 3 minutes and 20 seconds.

TIME REQUIRED FOR MAKING CHEEK MOLD ON CLOSET RING MACHINE.

One operator.	Time of each operation. Min.	Sec.	Elapsed time. Min.	Sec.
Lifts off cheek mold and sets on drag		20		20
Cleans pattern		59	1	19
Sets nails in core (2 minutes lost)		21	3	40
Cleans cheek flask		20	4	00
Puts on cheek flask		15	4	15
Sifts sand		47	5	02
Tucks and rams	1	17	6	19
Strikes-off		10	6	29
Raps and lifts cheek flask		14	6	43
Lifts, inspects and tucks down		27	7	10

Time required for making cheek mold on closet ring machine, 7 minutes and 10 seconds.

TIME REQUIRED FOR MAKING COPE CLOSET RING MOLD ON MACHINE.

One operator, average time ..... 4 minutes.

Summary.

TIME REQUIRED FOR MOLDING CLOSET BOWL.

	Minutes.	Seconds.
One operator makes drag in	8	15
One operator makes cope in	10	
Two operators make closet bowl core in	9	44
One man shakes out closet bowl in	7	22

Note.—The four men perform these operations at same time.

TIME REQUIRED FOR MOLDING CLOSET RINGS.

	Minutes.	Seconds.
One operator makes cope in	4	
One operator, same as above, makes drag in	3	20
One man makes cheek mold in	7	10

Note.—Four operators work on closet bowls and two on closet rings.

required for the operations noted herewith, indicates that the drag molder has little time to spare, while the man on the cope, and the two closet bowl coremakers finish their work in practically the same time. These four men make one complete mold, and it is therefore essential that their operations be concluded almost simultaneously. The same is true of the molders employed on the closet rings, both operators completing their portion of the mold in about 7 minutes and 15 seconds. The time for fitting the arbors together is variable, as this work can be done at any time without affecting the sequence of operations.

CARBORUNDUM PRODUCTS FOR FOUNDRY USE*

BY A. D. ROGERS

EVER since the discovery of carborundum by Edward G. Acheson in 1891, new fields have constantly been developed for this useful material. Its extreme hardness and sharpness makes it an ideal abrasive. Its refractibility and infusibility make it an ideal material for the lining of furnaces subjected to intense heat. Being a powerful deoxidizing agent, it is an ideal material in the manufacture of steel, increasing the fluidity and temperature to a marked degree. The uses of carborundum are so numerous that it would be impossible to enumerate them here, but the three I have already referred to are of especial interest to the foundryman.

Manufacture of Carborundum.

Before taking up the commercial side of carborundum, I will give you a brief outline of its manufacture. Carborundum is a product of the electric furnace, formed at a temperature of about 6,000 degrees Fahr.; it is derived from two of the most refractory materials known, carbon and silica, and if it were possible to combine all the valuable qualities of these two substances in one, the result would be an almost perfect refractory.

The electric furnace employed by the Carborundum Co. consists of a long, trough-like structure lined with fire brick. The ends of the furnace have built-in, carbon terminal rods to which are attached the cables conveying the electric current. The mixture of sand and coke is placed in the furnace around a so-called core of ground coke. This core completes the circuit between the terminals and offers a path of very high resistance to the electric current; the resistance thus interposed results in the generation of enormous heat. After the furnace has been run for a few hours there can be seen at all the joints and on top of the mixture, small blue flames of oxide of carbon, which have been produced by the reaction of the silica by part of the carbon. This reaction is immediately followed by the one which forms carborundum, since the silicon combines as it is formed with the excess of carbon.

Product in the Electric Furnace.

A cross-section of a carborundum furnace after the reaction is complete presents an interesting and beautiful appearance; the original core of ground coke is found to be very different in its characteristics. The high temperature to which it has been raised has driven off all impurities, leaving nothing but pure carbon, either in the amorphous or graphitic forms. From the core radiate beautifully colored carborundum crystals; at a distance of about 12 inches, the crystals suddenly cease and instead, is found a thin layer, about two inches in thickness, of a light green color, which is the inner crust of amorphous carborundum or so-called fire-sand. Beyond this is another crust into which most of the impurities have been driven.

The crystallized carborundum having been ground and washed, and graded into the different sizes, is then ready to be made into grinding wheels, rub stones, sharpening stones, etc., of thousands of different sizes and shapes to meet the requirements of practically every branch of manufacture.

Abrasive for Grinding Steel.

Although the operation of abrasive wheels in the foundry seems a very simple problem, it nevertheless presents many interesting and complex sides. Choosing the proper abrasive of the right grit and grade to show the most efficient results on the material to be ground, has taken years of study and experimenting both on the part of the foundryman and the manufacturer. In this wide field, carborundum has proven itself a most important factor, showing its superiority in almost every branch over all other kinds of abrasives.

For a long time the Carborundum Co. has realized that the grinding of all classes of steels was a study in itself and that carborundum did not always meet with the same success in this branch as in some others. The failure of carborundum to meet some of the requirements of steel manufacturers and machinery builders, led F. J. Tone, works manager of the Carborundum Co., to experiment with and develop another electric furnace product which he has called Aloxite.

Aloxite.

Aloxite has a somewhat different chemical composition from carborundum and although not as hard, is much tougher. This material has got beyond the experimental stage and from numerous reports of tests received by the Carborundum Co., bids fair to take a place in the front rank of other abrasive materials in this very important field.

I will cite one case in particular that I personally witnessed, it being one of the first tests made of Aloxite, and was doubly gratifying in its results. At the plant of a large manufacturer of railway frogs, switches, etc., the Aloxite wheel was tried out in competition with several other wheels of well-known makes on manganese steel frogs. This wheel ground one frog in five hours against eight and one-half hours for the best competitive wheel. Another Aloxite wheel of a harder grade and coarser grit was tested on this same work, and the results were still more surprising.

I have referred to this particular test to show what was accomplished with this material in its experimental stage. Today we know more about it and are able to produce wheels of uniform grades, adaptable to the work to be ground. High speed tool steels, which have always been a severe test to abrasive wheels, are easily cut and ground, both wet and dry, with Aloxite wheels.

Carborundum Fire-Sand.

Carborundum fire-sand has many valuable characteristics. Among its physical properties it may be noted that it has a specific gravity of 2.7, is of a grayish-green color, granular and easily crushed. Chemically, it is classed with the so-called silico-

*Read before Philadelphia Foundrymen's Association by A. D. Rodgers, of the Carborundum Co., Niagara Falls.

carbides, which are compounds of carbon and silicon with or without oxygen. In an oxidizing atmosphere it slowly undergoes a surface oxidization.

Carborundum fire-sand is of especial interest to the foundryman on account of its wide use in the construction of brass melting furnaces. With the introduction of fuel-oil and gas-fired melting furnaces new conditions were encountered.

The most exacting conditions, however, in the matter of resistance to the high temperature of the oil flame and the scouring action of copper and brass slags are met by the use of carborundum fire-sand. Mixed with the proper binding materials, the entire lining may be rammed up in a solid block, having no joints and presenting a smooth glazed surface of high refractivity and good mechanical strength. For this purpose, silicate of soda is the binder most commonly used. When thoroughly incorporated, the constituents form a plastic mixture, which is easily molded and has a sufficient cohesion when tamped into place to retain its shape until fired. A center of iron or wood is provided, the dimensions of which conform to the shape required for the interior of the furnace. The fire-sand mixture is rammed solidly between the center and the iron shell of the furnace and after the removal of the center, the lining is dried out with a slow wood fire. By bringing the furnace slowly up to heat, it can be at once put into service. This method of molding the entire lining into place has many advantages, the most important being that it avoids the weak feature of joints.

Molds for Aluminum Castings.

This very remarkable thermal conductivity of carborundum has recently received an interesting application in the manufacture of molds for cooling aluminum in order to rapidly chill the cast metal. Aluminum, as moreover all other metals, becomes much denser when it is cast in a carborundum mold, which rapidly extracts heat from the cast metal. By this there is produced a sort of temper which gives the metal a much finer and denser structure. Sand molds, on the other hand, being poor conductors of heat, cool the metal very slowly and in consequence allow all the constituents of the metal the time necessary for crystallization and segregation. The manufacture of these molds consists, according to the inventor of the process, in dry mixing fine carborundum powder with sugar and clay.

The mixture is moistened with sufficient mortar to give a plastic mass to which is given the shape of the desired mold; this is then baked. These molds also possess the advantage of being much lighter than metallic molds and of being readily broken, crushed, reduced to a fine powder and re-agglomerated into a different shape.

To conclude what has been said regarding the action of heat on carborundum, we would add that it is completely unfusible at the very highest temperatures, but that it suddenly decomposes into its two constituents, one solid, the other gaseous, when the power of the source of heat has become very large, without however passing into the liquid state.

Silicon Metal.

Silicon metal is still another electric furnace product produced at the plant of the Carborundum Co. Ten years ago, metallic silicon or silicon metal, was a comparatively rare substance and was classed as a laboratory curiosity; by the close study of the science of manufacture and by use of the electric furnace, the Carborundum Co. has placed it among the commercial metals and made it available for practical use. Its chief use is in the refining of steel and is of practical economy to the foundryman and steel maker, in that it produces quicker and better results in making dense castings.

An analysis of the 90 per cent. or most popular grade of silicon metal, is as follows:

	Per cent.
Silicon	90.60
Iron	6.70
Manganese	0.08
Aluminum	2.35
Phosphorus	0.02
Carbon	0.22
Sulphur	none.

From this analysis it will be noted there is an entire absence of sulphur, and it contains over 2 per cent aluminum, which is a powerful de-oxidizing agent. Although used principally by steel makers, it is destined to have a large field when alloyed with other metals.

DRESDEN CONVENTION OF THE GERMAN FOUNDRYMEN'S ASSOCIATION

A SUMMARY of the transactions of the Dresden Convention of the German Foundrymen's Association, so far as they may interest American foundrymen, is given herewith. A complaint by some of the members that the blast furnaces were trying to withdraw the customary allowance on the weight in pig iron shipments, was discussed, and inquiry among foundrymen, made previous to the meeting, indicated that such allowances were still in vogue, but that the amount varied. It was therefore recommended that the allowance of 1 per cent formerly fixed by the Rhenish-Westphalian Pig Iron Syndicate, and still used, be made the standard to be required. Dr. Grabenstedt then gave a talk on the work and the objects of the German Metal Trades Association and the relation of the German Foundrymen's Association to it. It was decided to retain specialists in connection with the investigations of the association along technical lines, and to compensate these specialists therefor. Dr. Brandt, secretary, then reported on his efforts to create a live interest in the work of the association, and made a number of recommendations regarding the admission of individual members of firms, as well as engineers, chemists, and other officers of works, admission being heretofore for firms only. Finally, Baron von Gienanth, the chairman, reported on the specifications for pig iron adopted by the American Foundrymen's Association, and the action of the International Society for Testing Materials thereon, and urged the study of the question by the proper committee of the society. This was duly ordered by the executive board, and it was further decided to join the German Society for Testing Materials.

Foundry Coke.

At the first session, Prof. Simmersbach discussed the properties of good foundry coke. He explained the reason for the comparatively higher price of foundry over blast furnace coke, as due first to the fact that only selected

pipes were taken from the various coke charges, and second that foundry coke is bought on a smaller scale. For practical purposes, however, the difference between the two classes was too slight to be detected by any satisfactory method, and the reasons given above were those of the coal syndicate of the Ruhr region. Proof was given by means of a set of charts showing the composition of both kinds of coke from the same ovens. Prof. Simmerbach went into the subject thoroughly, bringing out the desirability of a high heating value of coke, as influenced by its porosity, then the melting value as affected by the percentage of ash and moisture, and finally the purity of the coke, in regard to freedom from excessive sulphur.

Chief Engineer Krumbiegel then read a paper on the use of soft coal briquettes in iron and steel foundries. This referred principally to the generation of steam, and the making of gas with these briquettes, and using this gas in the air and the open-hearth furnace for melting purposes.

Use of Cast Borings.

Engineer O. Leyde then read a paper on the use of cast borings in the cupola. He advocated briquetting, not only cast iron borings, but also those of brass and bronze. By this method, instead of boxing them and then charging for melting, better results were obtained. After the session, Mr. Gutman exhibited the molding and pouring of sanitary ware by moving pictures.

A visit was made to the Technical School of Dresden, and an able address was delivered by Geheimrat Kuebler. Special attention was called to the present demand for a complete, healthy, universal technical education for the middle grade of workers, instead of the former and now disappearing tendency to specialize the vocation schools of middle class, and to generalize the higher technical schools. The engineer of today must become a specialist, where formerly he could undertake all classes of work. On the other hand the foreman, superintendent, in fact the skilled workingman should receive a general technical education, so that in his vocational work he may operate to the best advantage, wherever he may be and on what employed. There was therefore a great advantage in having permanent exhibits of machinery at work, and of supplies in connection with these schools, and the greatest amount of good would come from them for the industrial life of the nation.

At the main session of the society, the president, Dr. Uge, welcomed the members and their guests of other industrial and technical societies. He regretted that Dr. Moldenke, of the American Foundrymen's Association, who had expected to be present to transmit the greetings of the American society, had at the last moment been forced to change his plans, on account of government commissions, and could only send his regrets and best wishes. The president reviewed the activity of the society since its organization, announced that the government had approved of the specifications for cast iron and finished castings, other than pipe, and then discussed the question of specifications for foundry pig iron, and the action of the Copenhagen congress. He then announced that the Mining School of Clausthal had arranged for a course of study intended specially for the training of foundry engineers. Export matters then came up for his attention, as well as the policy the society wished to pursue in regard to tax and political matters. Attention was called to the widening of the scope of the society from a simple business gathering, to taking up technical questions as one of the chief objects. The collapse of the pig iron syndicate, with the consequent competition in blast furnace circles, had twice brought about a reduction in the price of furnace coke. The foundries had been left out in both cases by the coke syndicate. Consequently, an attempt had been made to get coke contracts shortened to six months instead of a year. Investigation, however, had shown that foundrymen preferred the yearly contract, rather than take advantage of changes in price, particularly as this might on occasion work the wrong way.

Specifications for Foundry Coke.

Baron von Gienanth next reported in detail the negotiations between the society and the coke syndicate, regarding the specifications for foundry coke. Some interesting questions came up in this connection. Thus, the syndicate objected to the method of taking samples. This was then agreed upon, but the claim was made that inasmuch as the syndicate sold its coke f. o. b. works, that all samples should be taken there, and they were not responsible for the analysis of the coke as it arrived in the foundry. Further, the claim for advanced prices was based on the fact that foundry coke was picked out by hand at the ovens from the various charges. This seemed to strike the committee of the foundrymen as rather queer, and proof was sought and found that the foundries got just what the furnaces did. All German coke is of the by-product variety, bee-hive ovens being no longer in existence.

Finally the committee tried to get a minimum sulphur specification, and this was also refused on the ground that those coke works that made high sulphur coke, did not sell to foundries. Here again the committee found the explanation rather vague. As to ash and water content, no concessions were allowed the foundries in the way of guarantees and specifications, even though it was shown that the blast furnaces had these. The syndicate said simply that they did not propose to extend the specification system to foundries. The only gleam of light the foundrymen's committee could get was a promise on the part of the syndicate that it would urge its members to be more sparing with the water in quenching their coke. The committee therefore regretted that it could report very little progress.

After a thorough discussion, resolutions were adopted urging the foundrymen of Germany to take united action requiring fair treatment, and in view of the embitterment of foundry owners, a radical change in the manner in which requests for adjustment of business differences were handled.

German Industrial Conditions.

The secretary, Dr. Brandt, next read his annual report, which dealt principally with industrial conditions in Germany. He reported that the upward movement was finally apparent. Among the disagreeable conditions that the foundry labored under was the requirement of large mills having no foundries, that all their casting purchases from the foundries entailed an exchange on the basis of pig iron instead of cash, or practically a trade instead of sale. The foundries would then have to use this iron before they realized their expenditure in the production of castings. Next came the prevalent custom of bribing officials to obtain orders. Laws had not been enacted, which would curtail this evil practice to any extent. On account of the depression through which the country had just passed, strikes and other labor troubles had not been so great. There are about 2,300 associations of manufacturers in Germany. These have as members about 180,000 manufacturers, and employ 1,400,000 workingmen. The German National Metal Trades Association has 6,144 members, and employs about one million men. An object, which is now followed particularly, is the placing of workmen through employment bureaus of these associations.

Politically, this has become an important matter, and Dr. Brandt went into the details of this movement very thoroughly in his report. The national economy, tax questions, laws, etc., were next gone into at length. Car shortages and the union of railroads to prevent this as much as possible; long distance telephone charges, postal cheques and savings laws, banking laws and commercial treaties, the United States tariff, French and Canadian tariff problems, patent matters and the purely social and political questions of Germany concluded the very able and elaborate report of Secretary Brandt. A discussion of the employment bureau question followed and the treasurer's report was then read. No election of officers was held this year, the old board remaining.

German Foundry Foremen's Association.

Editor Haentzschel then addressed the society on the aims and objects of the German Foundry Foremen's Association. It seems that there are 16 local associations, and the national body now has 800 members. The objects are entirely educational, following the American idea, and conventions are held annually.

MOLDING SMOKE STACK EXTENSIONS

By Paul R. Ramp

A smoke stack extension, about 36 inches in diameter at the base, 20 inches in diameter at the top and about 4 feet high, is shown roughly in Fig. 3. The original method of molding these castings is shown in Fig. 1. The large dry sand core is not only expensively produced, but will require considerable time to dig out after the casting has been poured. There is also considerable danger of losing the casting when molded in this way as there are so many points that must be absolutely tight to prevent a runout, and furthermore, there is danger of the mold being crushed if the cores do not come out of the oven absolutely true.

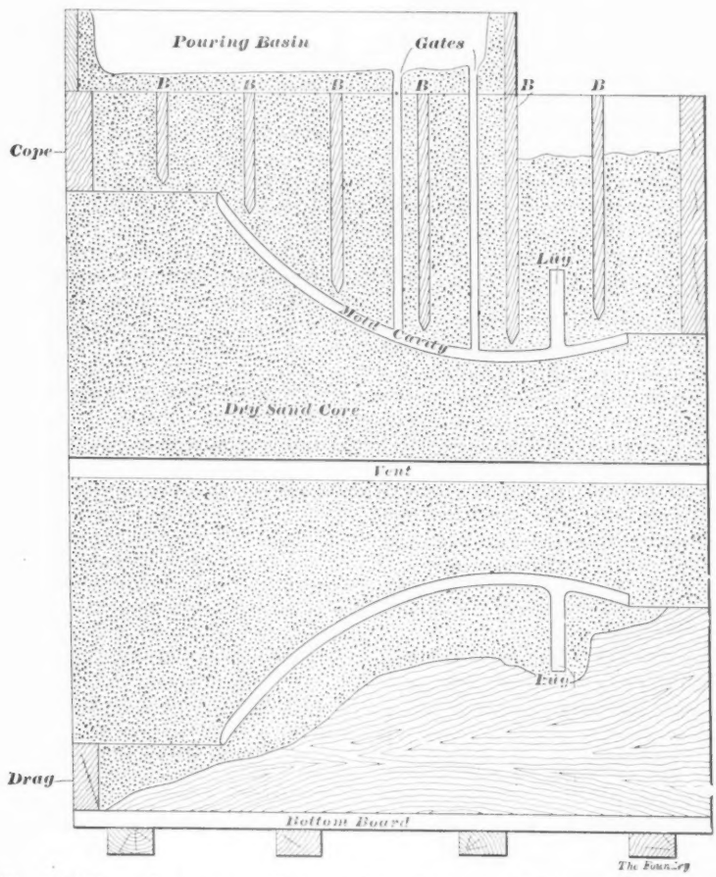


Fig. 1—Cross-Section of Stack Mold Showing Obsolete Method of Molding

The proper method of molding this casting is shown in Fig. 2. This was adapted after that shown in Fig. 1 was abandoned. A three-part flask is used with chuck bars in the cheek. These are not extended up to the top of the joint of the cheek as is done in ordinary practice, thus reducing the labor in tucking bars and ramming. The bars are made only of sufficient length to carry the sand above them, a few gaggers being placed along the sides. The cope is only 6 inches deep, but is strengthened with bars that are cast in when the cope is made. The lifting plate is simple and can be cheaply made.

The drag is not rolled over, but is rammed, struck-off, the lower section of the pattern is placed on it, and the inside of the same is rammed up to a point where the anchor plate is to rest. This method reduced the cost of molding approximately 50 per cent, and the cost of making the large dry sand core is entirely eliminated. Heretofore, one molder and a helper put up one mold per day, whereas the output by the new method has been doubled. This shows that no set rules can be applied to foundry practice, inasmuch as it is generally conceded that a mold made in a three-part flask is more expensive to produce than one made in a two-part flask. However, in this case the three-part mold is produced at a cost of 50 per cent less than the one made in a two-part flask.

INSURANCE FUNDS AND PENSIONS PLAN FOR FOUNDRY EMPLOYES.

The Employers' Association of Buffalo has made arrangements with a Detroit casualty company for issuing insurance policies to the employes of the members of its shops, which embody accident, sickness and death benefits. The first policy was written in March, 1909, and up to the present time, 1,200 have been issued to employes of the members of the Buffalo Employers' Association. The death benefit thus far is only $100, but may possibly be increased in the near future. The rate is only $1 per month, and half policies with half benefits are issued at 50 cents per month, to those who cannot afford full policies.

Benefit Insurance.

Deere & Co., agricultural implement manufacturers, Moline, Ill., have inaugurated a benefit insurance fund for their employes, as well as a pension plan for those who have been incapacitated for further work, either by reason of age or disability. All of the emloyes of Deere & Co., paid through the weekly pay-roll, derive the benefits of the insurance fund as soon as they sign the employment contract and begin work for this concern. Sick benefits, at the rate of $1 a day for 60 days after the first week of sickness for disability resulting directly or indirectly, wholly or in part, from paraly-

sis, lumbago, tuberculosis, cancer, etc., are paid. One dollar per day is paid for 180 days, after the first week of sickness, for disability due to other illness not outlined above and not of a chronic nature. Benefits are paid at the rate of $100 for death resulting from sickness and occurring within the time during which benefits are paid. Free medical attendance is provided, not exceeding one visit per day, by any one of the company's staff of eight physicians. One-half benefits are paid to employes rated at less than 15 cents per hour. These benefits are payable only to employes who have been in the service of the company four consecutive weeks during the 12 months previous to disability. Death benefits are payable only in cases of death of the employe, who has worked for the company continuously for the three months just previous to death, or has worked a total of six months out of the 12 months. One dollar per day for 12 months, after the first week, is paid for disability due to accident received when not employed elsewhere than by Deere & Co., and benefits claimed for accidents not occurring at this company's plant will be considered on their individual merit. Free surgical attendance is provided.

Accident Benefits.

The following special death benefits are provided: For injuries resulting in the death of an employe before the expiration of the 12-month benefit period, $1,000 shall be paid; for the loss of both hands or both feet, one hand and one foot, the employe shall receive $1,000; for the loss of one hand or one foot, $500; for the loss of sight of both eyes, $1,000; for the loss of sight of one eye, $250; for injuries resulting in the loss of two joints of any finger, $100. Half of the cost of this insurance is borne by the company, while the employes are charged 50 cents per month.

Pension Fund.

The pension fund is provided by Deere & Co. without cost to its employes. All employes engaged in any capacity in the operations of this concern, who have reached the age of 65 years, and have been 20 years or more continuously in the service, may be retired and become eligible to a pension. Furthermore, any employe who has been 10 years or more continuously in the service of the company, and has, by reason of injury or sickness, become totally incapacitated for further work, may or may not receive aid from the pension fund, at the discretion of the company. No person entering the employ of Deere & Co. later than the age of 45 years is eligible to a pension. The pension allowance for each employe retired for age is as follows: For each year of active service, 1½ per cent of the average annual pay during the 10 years next preceding retirement except that no pension shall be less than $18 per month; pension allowances are paid monthly from the date of retirement until death, and at the discretion of the pension board allowances may, in exceptional cases, continue to widows or orphans for a period not exceeding one year. The acceptance of a pension does not debar a retired employe from engaging in any business, which, in the judgment of the pension board, is not prejudicial to the company. The assignment of pension allowances is not permitted, nor can the same be taken for pensioner's debts by garnishment or otherwise.

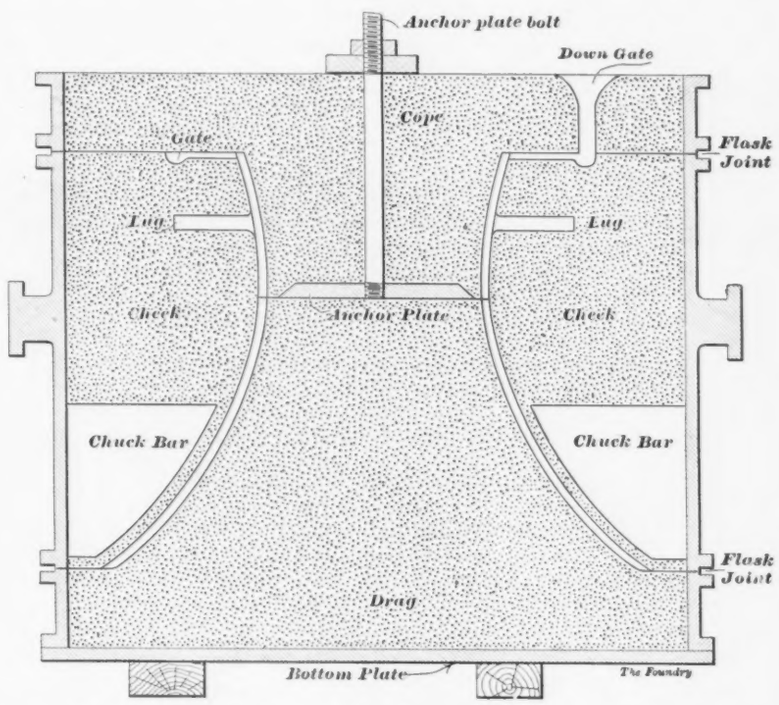


FIG. 2—CROSS-SECTION OF STACK MOLD SHOWING MODERN METHOD OF MOLDING

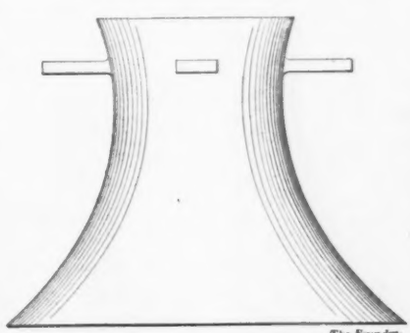


FIG. 3—THE STACK CASTING

UNIFORM PIG IRON SPECIFICATIONS.

At the November meeting of the Philadelphia Foundrymen's Association, held at the Manufacturers' Club, Nov. 3, Walter Wood, of R. D. Wood & Co., who recently returned from abroad where he attended the congress of the International Society for Testing Materials, outlined the manner in which uniform specifications for pig iron are being developed in England and Germany. Mr. Wood stated that the suggestions received from America were more complete than those from any other country, including specifications for not only pig iron, but steel, cast iron pipe, car wheels, etc. One difficulty operating against the adoption of grading by analysis in England is the sale of pig iron on the metal exchanges. The tonnage in the warrant yards varies from 250,000 to more than 1,000,000 tons, and is entirely graded by fracture. In Germany marked progress has been made toward buying and selling by analysis, although the old method of grading by fracture has not yet been abandoned. A paper entitled "Products of the Carborundum Co. used in the Foundry," was read by A. D. Rodgers, representing the Carborundum Co., Niagara Falls, N. Y. This was the 190th meeting of this society, and President Devlin commented on the fact that 19 years of successful work have been rounded out.

THE OXY-ACETYLENE WELDING PROCESS

Use of the blow-torch in the repair of defective castings---Fusing metals and welding brass and steel

BY J. F. SPRINGER

IN THE new process of welding by means of the oxy-acetylene blow-pipe, two gases are employed, oxygen and acetylene. The latter is formed by the union of carbon and hydrogen, and when these unite heat is absorbed, but when acetylene is broken up into hydrogen and carbon, heat is given off. In the oxy-acetylene blow-pipe the heat, which is produced when the oxygen is consumed and that which is set free when acetylene is broken up, are both made to contribute to that wonderful intensity of heat developed with this device, which is said to reach a temperature of 6,000 degrees Fahr., or more.

Welding in the Foundry.

The great heat obtainable from this source is the means whereby great economies can be effected in foundry practice. Defective castings, which are cracked, contain blow-holes and other imperfections, may easily be repaired by this welding process. In Fig. 1 is shown a large brass casting weighing about two tons, which developed three large cracks when undergoing the machining operation. Their locations are indicated by the arrows in this illustration. By the use of the oxy-acetylene torch, the crevices were filled with brass, and after subsequent machining, the welded parts could not be detected. The oxy-acetylene blow-pipe provides a method of filling up cracks and cavities in castings with precisely the same material of which the section is made, not only in brass but in iron and steel as well.

Concentrated Heat.

Owing to the small flame which issues from the blow-pipe, the heat is highly concentrated, and in addition, the oxygen and acetylene are mixed before issuing from the burner. The oxy-actylene flame as exemplified in the system of the Davis-Bournonville Co., New York City, is of a peculiar formation. It consists of a minute, brilliant, central flame, which is enveloped by a rather large, dull flame, but it is with the brilliant, central flame that the great concentration of heat is obtained, particularly at the outer tip of the concentrated flame. The number of heat units actually obtained in the inner core of the oxy-acetylene flame amount to 7,758 B. T. U's per pound of acetylene, while the number for the entire flame is 21,850. The outer flame, therefore, develops the difference, or 14,092 B. T. U's, nearly twice as much heat as the inner flame. Its temperature, however, is not as great because the heat is more widely distributed. This widely distributed heat area makes it apparent, therefore, that complete combustion does not take place, and in the Davis-Bournonville system, is so arranged that complete combustion is not effected. It would be assured by the use of two and one-half volumes of oxygen to one of acetylene, whereas this blow-pipe is so regulated that only about one-half of this oxygen is supplied, thus producing a neutral flame that will neither oxidize nor carbonize metals operated on. The combination of carbon with oxygen, under suitable conditions, to form carbon monoxide is, comparatively speaking, a slow operation. If this is really the case we would seem to have an explanation of why the supply of a larger amount of oxygen to the blow-pipe will not result in as high a concentration of heat as is otherwise obtained. However, excellent protection is afforded the surrounding metal whereby the outside flame and the inner flame is concentrated on the surface where the repairs are to be made. There is a further advantage in the outer flame as it has a tendency to retard

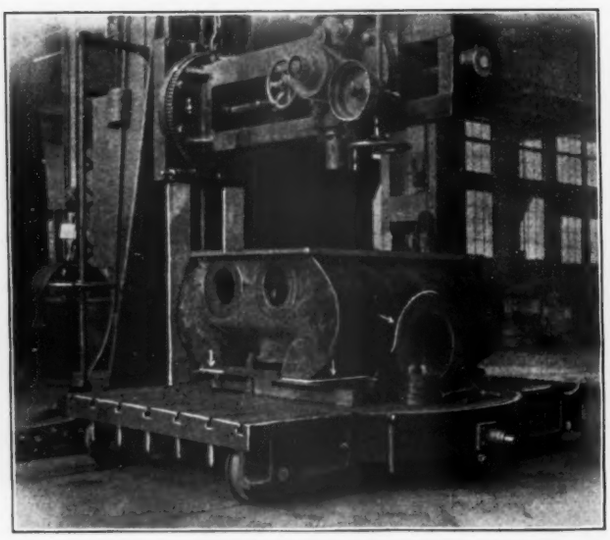


FIG. 1—TWO-TON BRASS CASTING REPAIRED BY THE OXY-ACETYLENE WELDING PROCESS

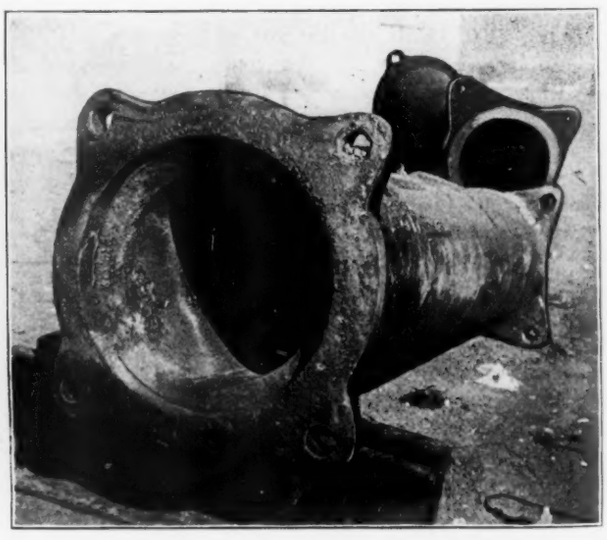


FIG. 2—CAST IRON PIPE CONTAINING BLOW-HOLES REPAIRED BY THE OXY-ACETYLENE WELDING PROCESS

the dissipation of heat from the inner flame.

The great advantages to be obtained by this and other welding processes is, that metals may be joined by fusion, which under the blacksmith's hammer refuse to coalesce. In fact, not many years have elapsed since the list of weldable metals was limited largely to iron and steel. Today, it is possible to unite brass with brass, copper with copper, cast iron with cast iron, and furthermore, brass may be welded to iron, cast iron to steel, etc.

Many castings, which can be made only with difficulty in one section, can rapidly be united by the fusion welding process. An important field for this line of work is in connection with machine frames. The usual method of constructing such machine is to mount a rotary spindle on standards, which project upwards from the main bed. This spindle is usually quite long, and it is very important that the bearings of the same on the standards should remain in perfect alignment. The production of these two parts of the castings in one piece would be very desirable, but this is difficult of accomplishment and the common practice is to bolt the standards to the bed. It would seem that the bed and standards might be so designed that they could be united by the fusion-welding process and if this were done, all of the advantages of the single casting would be obtained without undue expense.

Fig. 2 shows a section of cast iron pipe, 10 inches in diameter, which developed blow-holes while being machined. The defective parts of the casting were successfully repaired by the oxy-acetylene torch. This device has occasionally been termed a "putting-on" tool, and such in fact it is. In most of the welding operations new metal is added, and for this reason the process is somewhat similar to soldering. It is only with the fusion-welding process, however, that it is not necessary to use a different metal in order to effect the union, nor is it necessary to use a metal of low melting point, as precisely the same material may be used as that in the work itself. In filling in blow-holes or other cavities in castings, it is not sufficient merely to fill up the blow-hole but the walls of the cavity should be subjected to a high temperature, thereby securing a surface to which the new material can readily be united. If the operation is properly carried out the new metal will be so interwoven with that of the casting itself, that it will be difficult to locate the defect after machining.

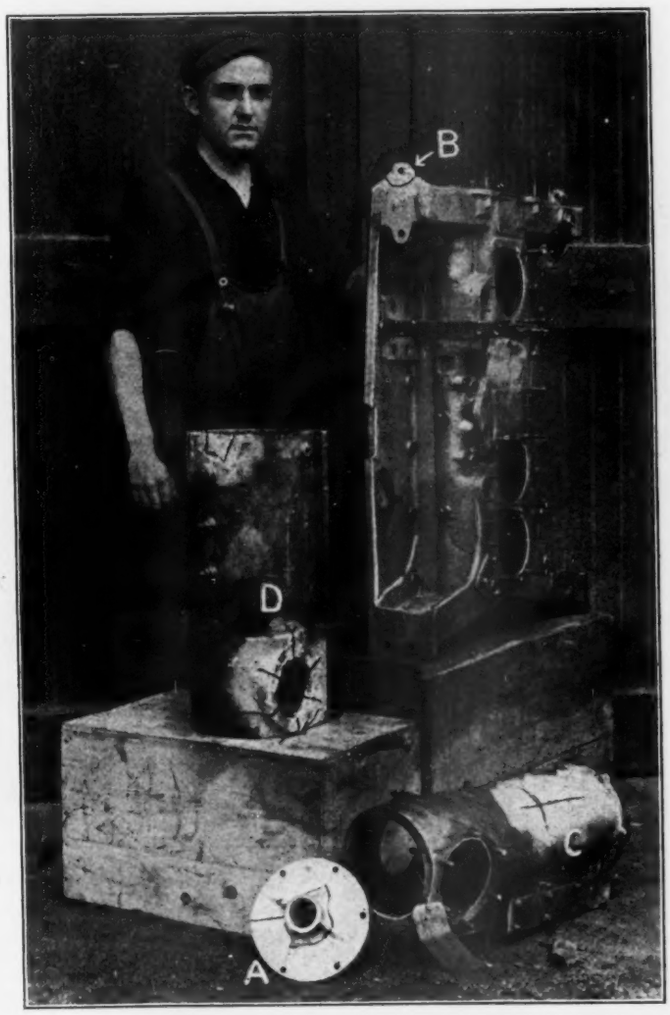


FIG. 3—DEFECTIVE ALUMINUM CASTINGS WELDED BY THE OXY-ACETYLENE BLOW-TORCH

Large Gear Repaired.

That fusion welding is in reality a putting-on process is indicated by repairs made on a 15-ton gear. Not only was a fracture extending across the full width of the rim successfully welded, but a tooth, 5 inches deep and 22 inches wide, was built-up and then machined to the proper dimensions. Nor is this welding process only of advantage on repair work, but it can afford great economies in correcting imperfections on new iron or steel sections. A large casting may be useless because, through some carelessness in the foundry or perhaps in the pattern shop, a minor part has been omitted from the pattern, or broken off in the cleaning department. In such cases it is entirely practicable to build on a new part of precisely the same material. Machining or cutting to shape may be necessary to complete the job, but the possibilities of saving a large casting will often justify a considerable expense, although the cost of operating the oxy-acetylene blow-pipe is of no consequence when the economies that can be effected are considered.

Another instance of putting-on new material may be cited. A small steel gear wheel, which was a part of an automobile transmission, had been so worn that it assumed the form of a bevel gear. As it was inconvenient to procure a blank or new gear, it was decided to restore this one to its original condition. By the use of the oxy-acetylene blow-pipe, sufficient new material was added to form a blank gear which, when machined and case hardened, was in effect, a new gear wheel. An engine piston weighing 500 pounds, 10 inches long and 12 inches in diameter, was lengthened 80 per cent by the use of the fusion welding process. However, if the part to be added to the casting is large it is not advisable to build it up entirely by the oxy-acetylene torch, as a new piece should be cast or otherwise formed and the two parts welded together. The lengthening of the piston was accomplished in this way.

In Fig. 3 are shown a number of aluminum castings upon which various welding operations have been performed. The round casting *A* was severely damaged, the entire center being broken out, but was re-

paired by the oxy-acetylene torch, aluminum being used to effect the fusion. The small lug *B*, at the end of the crank case, which was broken off, was similarly welded to the body of the casting. Fractures in *C* and *D* were similarly repaired.

When making such repairs, whether a fracture or a joint, the metal is cut out to form a V-shaped groove. If the work is large, it may be preheated. The operator applies the tip of the inner flame to the bottom of the groove, thereby melting some of the material of the main body of the casting or section to be repaired. When such a surface has been produced, new metal is added, but the operator must exercise care to fuse the sides of the groove to form a suitable surface for the attachment of the added metal.

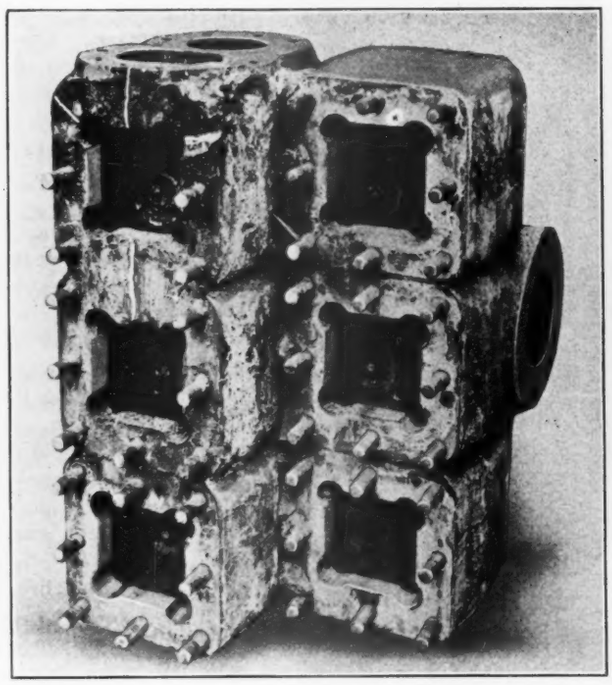


FIG. 4—WHITE LINES SHOW FRACTURES IN A LARGE IRON CASTING. REPAIRS WERE MADE BY THE OXY-ACETYLENE PROCESS

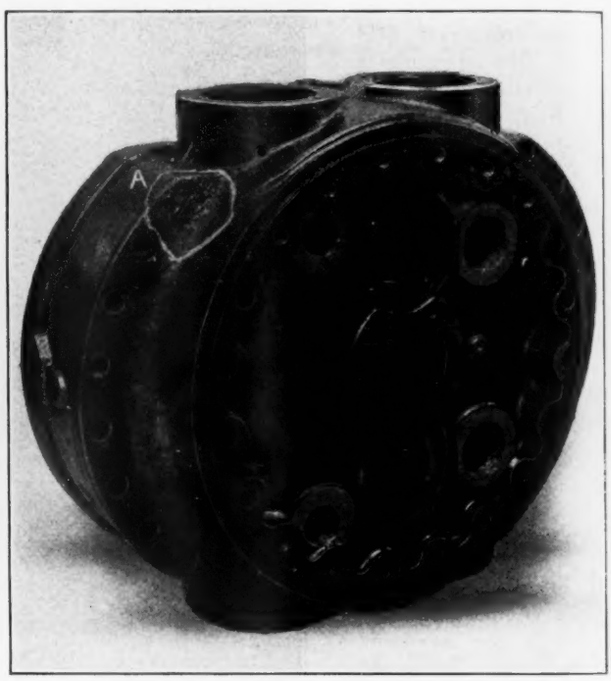


FIG. 5—DEFECTIVE AIR CYLINDER REPAIRED AT *A* BY THE OXY-ACETYLENE BLOW-TORCH

Welding Castings of Uneven Thickness.

Another example of repairs made by this process is shown in Fig. 4. This casting weighed over 2,000 pounds, and the fractures shown by the white lines consigned the section to the scrap pile. The metal thickness varied from 2 to 4 inches, and the welding of the casting of this section must be proceeded with carefully, as there will be considerable expansion due to the high temperature of the blow-pipe. This expansion is an important factor to be considered in applying the oxy-acetylene torch, and this difficulty may, to a large extent, be obviated by preheating the casting. In this way expansion can, to a large extent, be effected before the application of the blow-pipe. When making repairs on large, cast iron kettles containing fractures, it was considered necessary to preheat the general area involved. This was accomplished by turning the kettle upside down, and the fracture in the bottom, which was about 24 inches long, was cut out V-shape. A charcoal fire was then built inside the kettle, and the diameter of the metal, which was several inches thick, was considerably increased. A cherry red heat for iron and steel is desirable for the preliminary heating operation. The temperature may be maintained in part by the use of asbestos cloth, and this also forms a shield, protecting the operator from the heated surface while applying the oxy-acetylene torch.

Air Cylinder Repair.

In Fig. 5 is shown a cast iron air cylinder weighing about 1,800 pounds, upon which machine work costing about $300 had been done before a blow-hole was discovered when drilling one of the openings in the outer ring. The repair was made by the fusion welding process, and before machining, in shown at *A*.

In Fig. 6 is shown an automobile axle which illustrates the practicability of welding steel and bronze. The steel tubes are shown to the right and left and are parts of the axle, while the casting in the center is a bronze housing for the differential gear. These parts were united by the fusion welding process, the joints being made at *A*.

In Fig. 7, *A* and *B* are parts of a broken casting which were satisfactorily united by the fusion welding process, and at *C* and *D* are shown the two sections of a fractured press casting properly prepared for the welding process with the edges cut V-shape, and in Fig. 8 this casting is shown after the repairs have been made.

Welding on Parts of Castings.

An example of the adaptability of this process and the economies that can be effected in the foundry, is shown in Fig. 9. The section *B* of this pattern was left out of the mold and when casting, the boss *A* was omitted. The casting was intended for a gate valve, and a by-pass was to be located at the point where the boss was omitted. The forging *D* was successfully welded-on and sufficient metal added to permit of the correction of the defect. This cast steel valve weighed 650 pounds and

was saved from the scrap pile by this welding process.

Cutting Metals.

The cutting of iron, steel and other metals by the oxy-acetylene torch is a modification of the welding process. An auxiliary jet is added to the ordinary form of torch, which carries oxygen under pressure, and the outlet of this tip is close to that of the welding tip. To cut steel, a high temperature is first obtained at the desired point by means of the welding portion of the blow-pipe, and later, oxygen is projected from the jet provided for this purpose, and it will then be found that the steel can actually be burned. By moving the two companion tips, the oxygen jet being the follower, steel may be cut accurately to a line. This process of cutting-off by this torch can be used to advantage, especially in steel foundries, for cutting-off gates and risers.

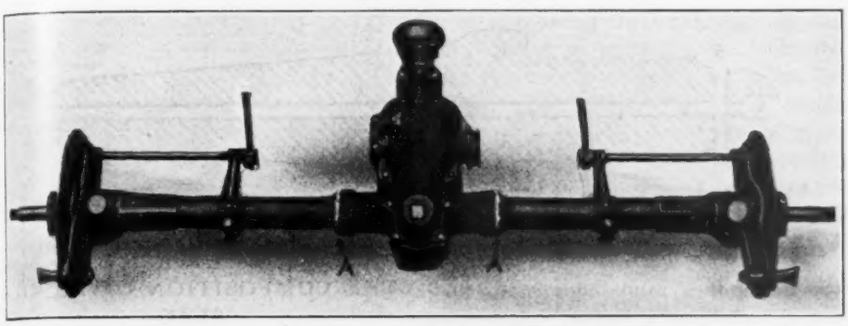


FIG. 6—AUTOMOBILE AXLE SHOWING AT *A* HOW STEEL AND BRONZE CAN BE WELDED TOGETHER

A cross-section of the Davis-Bournonville welding tip is shown in Fig. 10. The oxygen under greater pressure than the acetylene enters at *A* and comes in contact with four jets of acetylene entering at right angles through four orifices *B B*. The mixture of the two gases is completed in the opening *C* of the tip.

In the Davis-Bournonville system it is essential to supply sufficient oxygen to reduce the carbon to carbon monoxide, but not sufficient to produce carbon dioxide. For this reason it can readily be seen that the cross-section of the oxygen and acetylene inlets, as well as the outlets, must be proportioned to obtain this result. The amount of oxygen required to reduce acetylene to monoxide is equal to the acetylene in volume. To effect a combustion of dioxide two and one-half the volume of oxygen is required. The Davis-Bournonville Co. had already decided upon the ratio of 1.28 to 1, when the Academy of Sciences, Paris, France, decided on 1.30 to 1, thus substantiating the previous determinations of this concern. If a smaller amount of oxygen is supplied there will, in all probability, be a carbonized effect on the iron, on account of the portion of free carbon unsupplied with oxygen. If a greater amount of oxygen is used, the iron will undoubtedly oxidize.

As acetylene is an explosive gas it is necessary to make provisions against accidents. To prevent the possibility of the flame striking back into the acetylene tank, three safeguards are employed. In the handle of the torch is a packing of asbestos and mineral wool. This permits the passage of the gases but not the flame. If a spark should pass through this packing, however, it must pass through another filtration chamber, and back of this there is an intervening chamber nearly full of water which is the flash-back cylinder. The flame, in order to continue toward the reservoir of acetylene, would have to pass from the surface nearly to the bottom of the body of water, where the opening in the tube is located, which connects with the tank. It can, therefore, readily be seen that ample provisions have been made to prevent any possibilities of flash-backs, and that dangers from this source have been practically eliminated.

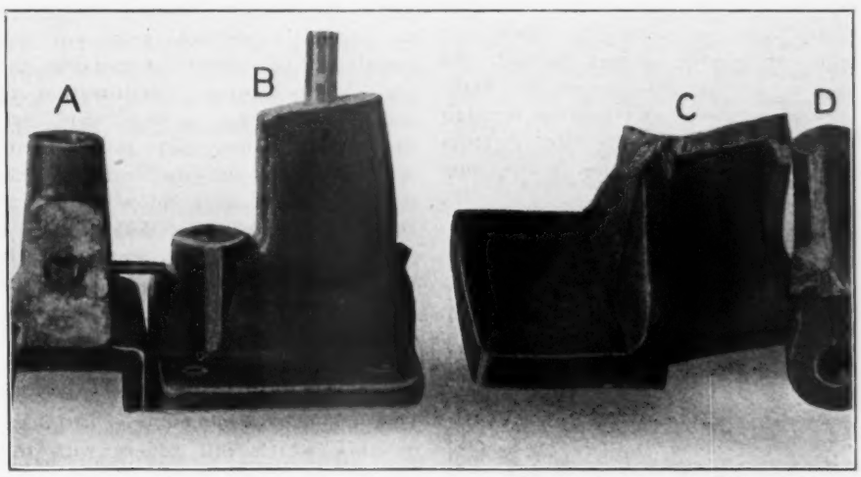


FIG. 7—*A* AND *B* ARE TWO SECTIONS OF A BROKEN CASTING BEFORE WELDING. *C* AND *D* ARE FRACTURED SURFACES PREPARED FOR THE WELDING PROCESS

Acetylene Generating Tank.

There are two processes by which acetylene gas is produced. One provides for the dropping of water on the calcium carbide, and the second process provides for dropping small lumps of carbide into a large body of water. It is the latter method that is carried on in the Davis pressure generator, built by the Davis-Bournonville Co., New York City, and shown in section in Fig. 11. There are two plugs, *K K*, through which the carbide is introduced into the hopper, shown in dotted lines. The bottom of this hopper is vertically removed a short distance from the lower end of the funnel, and is rotated on a vertical shaft operated by a clock-work motor on top of generator. The space between the movable bottom and the funnel is partially occupied by a number of guides, *F F*, hung on chains. When the bottom is rotated against the guides, lumps of carbide are dropped gently into the water and acetylene is formed. The gas rises to the surface of the water, and the lime sinks to the bottom of the tank, where it may be drawn off from time to time. When the gas rises to the upper part of the tank, it is carried off through tubes and delivered to the blow-pipe. A controlling diaphragm made of rawhide, is shown at the top of the tank, which is connected on its upper side with a lever provided with an adjusting weight, *Z*, whereby the pressure on the dia-

phragm may be regulated as desired. When the lever is raised to a certain minimum height, the clock-work motor is thrown out of action and the rotation of the hopper bottom ceases. At the same time the dropping of carbide into the hopper is

FIG. 8—CASTING REPAIRED BY THE OXY-ACETYLENE WELDING PROCESS, TWO PARTS OF WHICH, *C* AND *D*, ARE SHOWN IN FIG. 7

stopped. However, as the pressure is lowered, the lever is raised, sets the clock-work in motion, and the generation of gas is resumed. A gage *M* is provided by means of which the weight *Z* may be adjusted to stop the generation of gas at any desired pressure. This is usually fixed at 10 pounds per square inch. The blow-off valve *P* may be set to open at 15 pounds. The generated gas, in order to reach the point of service, passes through the tube *I* to the bottom of the flash-back chamber *G*, and passing through the water, it enters the filter *J*, from which it passes into the service pipe *U*, to the welding tip.

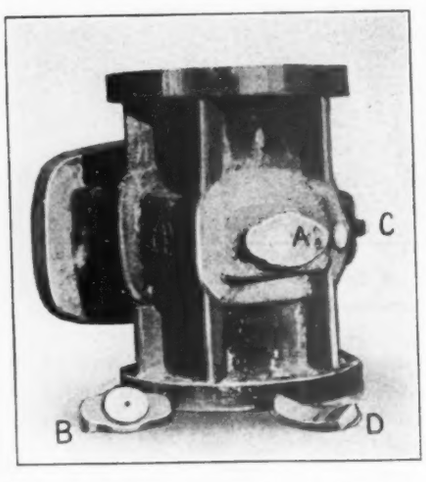


FIG. 9—IMPERFECT CASTING SHOWING HOW PARTS LEFT OFF THE PATTERN CAN BE WELDED ON

BLOW-HOLES IN CASTINGS CONTAINING CHILLS.

BY W. J. KEEP

Question:—I am experiencing some difficulty in casting vises that have a steel chill cast into the jaws. Usually when they are machined, blow-holes develop on the surface between the gray iron and the chill, and have tried a number of remedies, including more open sand, finer sand, coating the chill with linseed oil, tinning the same, covering the chill with borax, etc., but none of these has given the desired result. My idea is that moisture condenses on the chill, but it seems to me that the molten iron should evaporate this moisture. The analysis of the iron I am using is silicon 2.40 per cent, sulphur, 0.08 per cent; manganese, 0.55 per cent; phosphorus, 0.65 per cent; combined carbon, 0.10 per cent.

Answer:—If the chill is used to produce a hard surface on the casting, the silicon content is too high. On the other hand, if the chill is the jaw or the face of an anvil, and is to become a part of the casting, great precautions should be taken to insure a perfect union of the metals. The object of coating the chill is to prevent condensation of moisture on the surface, thus oxidizing the same, and as the iron will not unite with the rusty surface, it will thus cause blow-holes. If the surface is to act as a chill, it should be coated with kerosene. If the chill is to be united with the cast iron, tinning is desirable, but rather expensive. Would suggest coating the surface of the chill with thin silicate of soda, and powdered ferro-manganese should be sprinkled on this, which will adhere with the silicate when it dries. If you can leave the molds open and set the steel chills just before pouring, and while they are quite hot, it will prevent blow-holes. Furthermore, this difficulty can also be obviated by pouring the mold from the bottom and permitting a small quantity of the metal to flow out through a riser, which will carry off the gases. Your coke is also evidently too high in sulphur, and have doubts as to the correctness of your analysis, on account of the low combined carbon. If you cover the surface of the chill as suggested, thereby preventing oxidation, your difficulty should be overcome. As a last resort, would recommend placing in the ladle, before catching the iron, one-half ounce of pure aluminum to 100 pounds of metal. This will aid in the elimination of blow-holes.

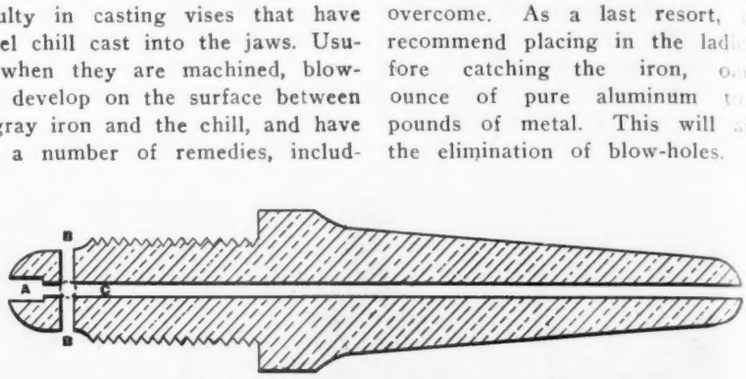


FIG. 10—WELDING TIP OF THE OXY-ACETYLENE BLOW-TORCH

THE COMPOSITION OF CUPOLA SLAG.

Question:—We are of the opinion that our cupola slag contains an unusually high percentage of oxide of iron. We would like to know whether it is possible to control the nature of our cupola slag from day to day, and if so, would the averaging percentages of impurities indicate the quality of iron we are securing? The analysis of our cupola slag follows:

	Per cent.
Silica	48.41
Alumina	15.27
Lime	17.87
Magnesia	3.22
Manganese	1.60
Oxide of iron	13.14
Metallic iron	9.20

Answer:—It is evident from the anal-

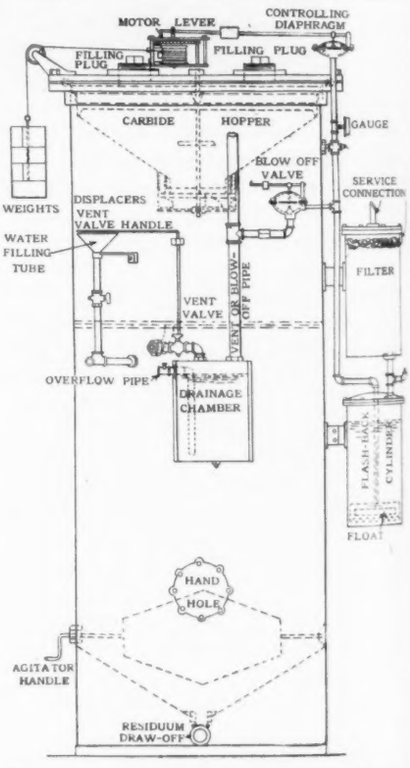


FIG. 11—DAVIS-BOURNONVILLE ACETYLENE GENERATING TANK

ysis that if the cupola had been run with more limestone and if the iron had been melted as hot as possible, the percentage of oxide of iron would have undoubtedly been considerably less, and the metallic iron would likewise have been reduced. Herewith are given a number of analyses of cupola slags, which show a wide variation:

Cupola slag of a western foundry:

	Per cent.
Silica	37.10
Alumina	9.16
Lime	8.98
Magnesia	8.44
Oxide of iron	13.73
Metallic iron	9.61
Manganese oxide	2.77
Sulphur	0.36

ANALYSIS OF SLAG FROM A CUPOLA MELTING CAR WHEEL IRON. THE FOUNDRY IS LOCATED IN THE NORTH.

	Per cent.
Silica	44.00
Alumina	9.76
Lime	15.99
Magnesia	7.27
Oxide of iron	13.16
Metallic iron	9.21
Manganese	5.79
Sulphur	0.78

There is nothing to be gained in a practical way by observing these slags from a laboratory standpoint. The whole matter reduces itself to the operation of the cupola with the least possible oxidation and the use of sufficient flux to insure a fluid slag to carry off all of the waste products. It has also been ascertained by experience, that the lower the blast pressure the thinner the slag must be to run off easily. When the slag wool is blowing from the slag tapping hole, it is a pretty good indication that the cupola is operating normally.

The two analyses of the cupola melting gray iron with and without fluor-spar showed no great variation, and so far as could be determined by analysis there was no appreciable difference in the slags.

An ideal slag should contain approximately 40 per cent of silica. If the slag is fluid the metallic iron will fall through it and the increase of lime will have a tendency to decrease the oxide of iron. The use of rusty scrap will produce a dark colored slag caused by the iron oxide.

IRON MACHINERY CO.
PATTERN CARD

DATE _____ PATTERN NO. _____
MATERIAL OF CASTING _____ GATE
NAME _____ YES NO
MACHINE _____ PIECES PER GATE
PIECES PER MACHINE _____

WEIGHT		NO PARTS	NO LOOSE PIECES	MATERIAL
ROUGH	PATTERN			
FINISHED	CORE BOX			

THIS CARD MUST ACCOMPANY PATTERN

The Foundry

FIG. 1—RED CARD, 3 x 5 INCHES, ATTACHED TO EACH PATTERN

IRON MACHINERY CO.
PATTERN EXCHANGE CARD

DATE _____ PATTERN NO. _____
MATERIAL OF CASTING _____ GATE
NAME _____ YES NO
MACHINE _____ PIECES PER GATE
PIECES PER MACHINE _____

WEIGHT		NO PARTS	NO LOOSE PIECES	MATERIAL
ROUGH	PATTERN			
FINISHED	CORE BOX			

THIS CARD MUST BE EXCHANGED FOR RED CARD

The Foundry

FIG. 2—PATTERN EXCHANGE CARD, 3 x 5 INCHES

ANALYSIS OF SLAG FROM A CUPOLA MELTING CAR WHEEL IRON. THE FOUNDRY IS LOCATED IN THE SOUTH.

	Per cent.
Silica	48.77
Alumina	10.90
Lime	13.79
Magnesia	6.05
Oxide of iron	13.18
Metallic iron	9.23
Manganese	4.84
Sulphur	0.81

ANALYSIS OF SLAG FROM A CUPOLA MELTING GRAY IRON, NO FLUOR-SPAR BEING USED.

	Per cent.
Silica	42.84
Alumina } Oxide of iron	21.32
Lime	21.16
Magnesia	13.28
Manganese	2.34
Manganese oxide	3.01

ANALYSIS OF SLAG FROM A CUPOLA MELTING GRAY IRON, FLUOR-SPAR BEING USED.

	Per cent.
Silica	39.50
Alumina } Oxide of iron	22.82
Lime	24.50
Magnesia	11.05
Manganese	2.24
Manganese oxide	2.89

ANALYSIS OF SLAG FROM A CUPOLA MELTING MALLEABLE IRON.

	Per cent.
Silica	41.72
Oxide of iron } Alumina	22.24
Lime	17.84
Magnesia	15.06
Manganese	3.20
Metallic iron	3.82
Manganese oxide	4.12

A RECORD FOR PATTERNS SENT TO OUTSIDE SHOPS.

BY C. J. FREY

The Iron Machinery Co. did not operate a foundry and depended for its castings on two, and occasionally three, local casting shops. Its own pattern storage was too small for the constantly increasing number of models, and the wear and tear on the patterns, caused by the continual hauling back and forth, proved an expensive item. Loose pieces were frequently lost, notwithstanding the fact that the foundryman claimed he had returned the pattern complete, although the pattern shop record showed that they were still at the foundry. Shipments were frequently delayed, and to obviate a recurrence of these difficulties, a pattern record was adopted, which satisfactorily solved the problem. The foundries doing the work for the Iron Machinery Co. were well provided with fireproof, storage buildings and it was decided that the patterns should remain in the hands of the foundries unless changes were required. The foundries made all necessary temporary repairs and were responsible for all castings after accepting the patterns.

A card, Fig. 1, was filled out for each pattern and as noted, one is attached to every pattern. The card is printed on heavy red paper, while the exchange card, Fig. 2, is of a different color. For foundry No. 1, this exchange card is green, and for foundry No. 2, blue. No pattern will be received by either foundry unless the red card is attached to the same, nor will either of the casting shops surrender the red card without securing its exchange card in its place.

The green card is the receipt given to foundry No. 1 for the safe return of the pattern and all of its parts. A glance at the card case by the patternmaker or his clerk shows at once the location of the pattern. If a red card is in the case the pattern is in the company's storage, and if at foundry No. 1, a green card is in the case, and at No. 2, a blue card. The foundryman, upon the receipt of an order for castings, can tell by the color of the card he receives whether or not he has the pattern, but, of course, he is not in position to know whether it is at some other shop. Cards for patterns in almost constant use, must be frequently replaced, but this is a simple matter. This system may be extended to include any number of foundries by using exchange cards of different colors for each one.

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Molding Machine Results

The growing appreciation of the benefits to be derived from molding machine operations is reflected in the heavy demand for these labor-saving devices from foundrymen generally. Although the light work machine has been favored for many years and is extensively used, the economies that can be effected on large work are only now being properly recognized, and machines adapted for ramming molds weighing as much as 20,000 pounds are being installed by several concerns. The cost of labor for ramming is the big item of expense incurred in making large castings, and with the exception of a slight amount of finishing, this labor is entirely eliminated when power-ramming machines are used. The claim of molding machine manufacturers, that the larger the mold the greater the saving, has been verified by experience in many foundries engaged on heavy work, and these shops are adding this equipment as rapidly as the machines can be delivered. Nor are the economies limited entirely to the molding department, as cores of large dimensions can be made as readily as molds. In many plants, the core labor has been reduced fully 50 per cent by the use of power-ramming machines, and in addition to this large reduction in the production cost, the cores have given greater satisfaction than when hand-rammed, being uniform throughout, thereby eliminating many of the difficulties arising from soft and hard spots. To complete the sequence of machine operations on large molds, the proper sand handling facilities should be provided. The flasks should be filled with sand automatically from bins above the machines. This would obviate the filling of the flasks either by hand or by buckets, and would effect further material economies in the production of large castings. The wonderful results that can be obtained from mounting patterns on molding machines, even when the section is comparatively light, is strikingly illustrated in a report from one foundryman covering a period of 230 days. The record was obtained on one casting, made two in a mold by machine. The average output per day was 175 molds, and the price per mold obtained from good castings produced, was 2 cents. The weight of each mold was 10 pounds. The total weight of the castings made in the 230 days was 201¼ tons, the molding charges having averaged only $4 per ton. The total molding cost was $805. When this casting was molded by hand, the labor cost averaged $10 per ton, showing a saving by machine operations of $6 per ton, or a total of $1,207.50 during this period. Furthermore, a saving of 10 per cent in over-weight of castings, amounting to 20¼ tons, was shown, and with pig iron at $17 per ton the saving in over-weight alone amounted to $344.25. The total saving in iron and molding charges, as compared with bench work, amounted to $1,551.75. These results were obtained with one machine and one operator, who was furnished some help when pouring off, which is included in the record of costs.

Trade Outlook

Although there is a pronounced contrast between the continued heavy buying of finished material and the decided lull in the pig iron market, there is nothing to indicate a lowering of raw material values in the immediate future. The effect of the tremendous output of pig iron is undoubtedly being felt, and the consumption, while large, has probably not as yet adjusted itself to this increased pace. In spite of considerable inquiry the pig iron market has developed some soft spots, notably in the south, where the increasing pressure of speculative iron has had a depressing effect. Although it is denied that concessions have been made, it seems probable that a large purchaser would have little difficulty in shading the market on a good tonnage. Southern iron for prompt delivery is quoted at a maximum of $14.50 for No. 2, although it is believed that a round tonnage would develop a $14 price. In other centers, pig iron is quoted as follows: Bessemer, Pittsburg, $19.90; basic, Pittsburg, $18.15; No. 2 foundry, Pittsburg, $18.40; No. 2 foundry, Chicago, $19; No. 2X, New York, $19 to $19.25; basic, Philadelphia, $18.50; low phosphorus, eastern Pennsylvania, $22.50; Southern Ohio, No. 2 foundry, Cincinnati, $18.20. In the foundry trade there is a continued improvement in all branches, and prices, notably on gray iron jobbing work, have been materially advanced. The railroads continue to make heavy purchases of equipment and these, together with the extensive repairs to rolling stock, involve an enormous tonnage of malleable and steel castings. The brass and aluminum foundries are crowded for deliveries, the requirements of the

automobile makers being the heaviest in the history of the industry. The large number of new projects that are being launched, and the extensions that are being made to existing shops, reflect the present activity of the foundry trade. The producing capacity of steel, malleable and brass castings is being enormously increased, and it is estimated that no less than 150 new shops have been placed in operation during the last 12 months. The further absorption of aluminum casting foundries by one large interest is reported, and the plans of this merger, if consummated as outlined, will insure it a direct outlet for its product in every large manufacturing center in the United States.

PERSONAL.

H. S. Hastings, commissioner of the United Metal Trades Association of the Pacific coast, with headquarters at Seattle, has resigned to accept the position of general manager of the Independent Foundry Co., Portland, Ore.

W. G. Rowell, formerly of W. G. Rowell & Co., Bridgeport, Conn., brass founders, is now associated with R. B. Seidel, Inc., crucible manufacturer, Philadelphia, in the capacity of salesman in the eastern territory.

H. L. Hanson, formerly connected with the Columbia Steel Co., Elyria, O., is now connected with David Evans & Co., pig iron merchants, The Rookery, Chicago.

A. S. Blanchard, until recently assistant manager for the receivers of the Atha Steel Casting Co., Newark, N. J., is now connected with the Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., in the capacity of assistant general manager.

Dr. Richard Moldenke, Watchung, N. J., secretary of the American Foundrymen's Association, has returned from a three-months' trip to Europe. While abroad he attended the congress of the International Association for Testing Materials, held at Copenhagen, Denmark, and also visited Germany, England and France.

John McGeorge and H. W. Woodward have organized a consulting firm under the name of the Cleveland Engineering Co., with offices in the New England building, Cleveland. Mr. McGeorge was formerly chief engineer of the Wellman-Seaver-Morgan Co.

Geo. J. Chandler has resigned as sales manager of the Sterling Foundry Co., Pittsburg, to accept the position of sales manager of the Braddock Machine & Mfg. Co., Braddock, Pa. This concern has added an acid open-hearth furnace, and will engage in the manufacture of steel castings.

W. G. Murray, Chicago representative of Matthew, Addy & Co., Cincinnati, has resigned to become Chicago sales manager of Walter-Wallingford & Co., Cincinnati.

Chas. J. Caley has now severed his connections with the Russell & Erwin Mfg. Co., New Britain, Conn., and it is probable that upon his return from a western trip he will take up some line of manufacture, and may associate himself with Hoet & Cooley Co., New Britain.

Wm. A. Beveridge has accepted the position of foreman of the foundry of the Bridgeport Deoxidized Brass Co., Bridgeport, Conn.

William Vickers, who recently resigned his connection with Bellis & Morcom, Birmingham, Eng., was honored by his co-workers, who presented him with a magnificent marble clock at the Acorn Hotel, Birmingham. The presentation was made in the presence of more than 100 foundrymen and patternmakers. In addition he was the recipient of a handsome smoking cabinet from the members of the staff and a case of pipes from the foundry manager.

Hugh McPhee, formerly foreman of the Edna Smelting & Refining Co., Cincinnati, has accepted the position of foreman of the brass and aluminum foundry of the Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

DEATH OF EDWARD J. DENNEY.

Edward J. Denney, secretary of the International Molders' Union of North America, died at the Jewish Hospital, Cincinnati, Saturday morning, Nov. 20. Mr. Denney was born in Philadelphia, December 3, 1855, and was, therefore in his fifty-fourth year. He was a graduate of the Salem, Ohio, high school, and served his apprenticeship as a molder in that city. He later followed that vocation in Cleveland, and was elected secretary of the Iron Molders' Union in July, 1890, at the Detroit convention, and has served in that capacity continuously since that time, making Cincinnati his home. The work of his office was performed with great accuracy and with credit to himself and the association, and he enjoyed the fullest respect, esteem and confidence of his colleagues. Funeral services were held at the Saint Francis de Salles church, Cincinnati, November 22, and the remains were taken to Cleveland and interred in the Calvary cemetery on the morning of November 23. He was a member of the Local No. 3 of Cincinnati, whose members attended the services in a body. Floral tributes and telegrams of condolence were received from all parts of the United States. The officers and members of the executive board accompanied the body to Cleveland. Mr. Denney is survived by a widow and a son.

FOUNDRYMEN'S CONVENTION.

The annual foundrymen's convention will be held in Detroit, June 6 to 10, 1910, instead of during the week of May 30, as previously announced. The change in date was made in view of the fact that May 30 is Decoration Day, and it is doubtful if many foundrymen would have been present at that time. Arrangements are already being made for the exhibit which will be conducted under the auspicies of the Foundry and Manufacturers' Supply Association, and during this week the annual meetings of the American Foundrymen's Association, the American Brass Founders' Association and Associated Foundry Foremen will be held.

PITTSBURG FOUNDRYMEN'S ASSOCIATION.

At the monthly meeting of the Pittsburg Foundrymen's Association, held at the Fort Pitt hotel, Pittsburg, Nov. 1, Ellsworth M. Taylor, of Touche, Niven & Co., New York, who was a member of the cost committee of the American Foundrymen's Association, delivered an address on foundry costs and their relation to modern business methods. He emphasized the importance of a scientific method of determining costs in any line of manufacture and he described a system, which was a comprehensive scheme of business organization built upon a foundation of common sense. The speaker emphasized the importance of a flexible cost system, which would adapt itself to every possible condition incident to the expansion of a concern. F. H. Zimmers, secretary, in behalf of the committee on a permanent exhibit, reported that a number of foundry appliances are now being installed in the Carnegie Technical Schools.

MODERN EQUIPMENT FOR THE FOUNDRY

Rock-over, pattern-drawing molding machine --- Turbine blower unit for cupola service --- Arcade squeezer --- Portable core oven --- Sprue cutting press --- Melting furnace --- Portable, power-ramming molding machine

THE Barker rock-over, pattern-drawing molding machine, shown in the accompanying illustrations, is adapted for both large and small work, and patterns on boards or match-plates can be used. Both pneumatic and hydraulic power is utilized, the former for rocking-over the pattern and the mold, and the latter for dropping the flask away from the pattern. The pattern board or match-plate is attached to the rock-over arm by bolts, as shown in Fig. 2, this arm being pivotally mounted on standards, so that when the sand is rammed the mold and pattern can be rocked-over onto the table, which lowers the mold away from the pattern.

In Fig. 1, the match-plate containing the pattern of a fly-wheel is shown attached to the rock-over arm. The pattern is being returned to ramming position, the mold having previously been lowered away from the pattern plate, as shown in Fig. 2. When ramming a mold, the rock-over arm on which the match-plate or pattern board is mounted, is in a lowered position and rests on the stops attached to the cross bar of the machine frame. The flask is then placed in position, its lugs entering recesses in the match-plate or pattern board, thereby holding it rigidly in position. The mold is rammed by hand, and after the surplus sand has been struck-off, the bottom board is clamped to the flask. A valve is then actuated so as to allow air under pressure to enter the cylinder, which is connected to the arms carrying the pattern board or match-plate. The arm to which the mold is clamped makes a quarter turn, and after passing over the center, the mold is slowly lowered onto a vertically movable table. The air during the return movement of the piston is forced out of the cylinder through a cock, which wire-draws the air and permits the pattern and flask to settle slowly into position.

While the flask and pattern board are being rocked-over, the table is raised by operating another valve, which allows air to enter a tank, forcing the liquid into a hydraulic cylinder, thus elevating the table to a point directly underneath the overhanging flask. On the table are levers carrying a bar, which has supports for engaging one side of the bottom board, and a projection on the table contacts with the other side of the bottom board, so that when the table is brought under the flask, the levers accommodate themselves to the bottom board. After having adjusted themselves to the bottom board, the levers are locked in position, the flask clamps are removed and the mold is lowered away from the pattern by the descending movement of the hydraulic piston. During this operation the pattern is vibrated by a pneumatic vibrator. By the operation of an air cylinder, the arm to which is attached the pattern board or match-plate, is rocked back to its original position. This machine is sold exclusively by the J. W. Paxson Co., Philadelphia.

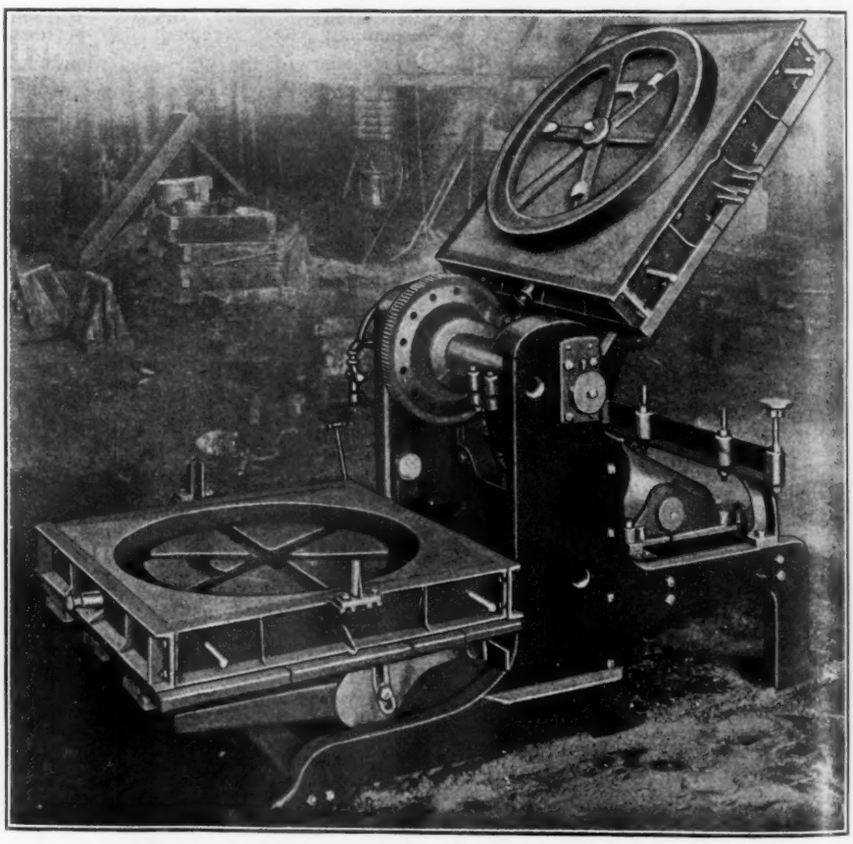


FIG. 1—ROCK-OVER, PATTERN-DRAWING MOLDING MACHINE, SHOWING THE PATTERN AS IT IS BEING LOWERED TO ITS ORIGINAL RAMMING POSITION

KERR TURBINES FOR OPERATING CUPOLA BLOWERS

The high rotative speed of the steam turbine renders it particularly applicable for direct-connection to a class of fans and blowers, which are required to supply a high blast pressure, and which, in order to do so, must necessarily operate at a high speed. In operating a high speed blower by means of one or more belts, it is necessary to provide means for tightening the same which, to prevent slippage, must either be run very tight or a long belt must be used. In either case there will be a heavy side pull on the bearings. Blowers, on account of their location

FIG. 2—MOLD LOWERED AWAY FROM THE PATTERN BY HYDRAULIC PISTON

in many foundries, receive very little or no attention, or in some instances owing to unskilled labor employed, there may be a lack of proper care. The Kerr turbine shown in Figs. 1 and 2, built by the Kerr Turbine Co., Wellsville, N. Y., is especially designed to meet these requirements, and is constructed in such a way that there is no frictional contact of the rotating element at any point except in the bearings, which are ring oiling and, therefore, require a minimum of attention.

With full steam pressure at the throttle valve, the turbine will reach full speed from rest in from five to eight seconds. The speed can be varied within reasonable limits by the adjustment of the governor. If desired, the turbine blower may be operated at any blast pressure by varying the steam pressure on the first stage nozzles by means of the throttle valve, the governor having been set for a limited speed corresponding to the maximum blast pressure required. The steam pressure as shown by a gage located between the inlet valve of the turbine and the first stage nozzles, may then be taken as an indication of the blast pressure, dispensing with the use of the blast gages.

A Kerr turbine blower unit, consisting of a 25-horsepower steam turbine, direct-connected to a Sturtevant blower for cupola service, is shown in Fig. 1. It will deliver about 4,800 cubic feet of air per minute at 12 ounces pressure, operating at 3,200 revolutions per minute. This set is very compact and occupies a very small floor space. The speed at which the blower must operate is the most advantageous speed for the turbine, and the combination is, therefore, ideal. The outfit can be easily operated, and it requires no further attention than the opening of the throttle on the turbine at the beginning of the heat, and shutting it off at the end of the melting period. The blast wheel of the blower is mounted on the turbine shaft with the turbine bucket wheels, and the entire rotating element is carried by two bearings, which are especially constructed for high speeds. The bearings are centered in each end of the turbine casing so that it is impossible for them to get out of line or to require any adjustment whatever.

In Fig. 2 is shown a Kerr steam turbine with pressure governor, coupled to a Buffalo Forge Co. blower for forced draft.

The Kerr steam turbine utilizes the principle of the Pelton water wheel, which has been so successfully used under high heads of water. The buckets are of the double cup variety, similar to the buckets of the Pelton water wheel, but they are made of a form suitable for the use of steam instead of water as the motive fluid. The shell of the turbine is made up of two end castings, between which are diaphragm castings, which contain the nozzles and divide the cylinder of the turbine into separate stages. The diaphragms are accurately centered with each other and with the two end castings, by turned and bored tongue and groove joints.

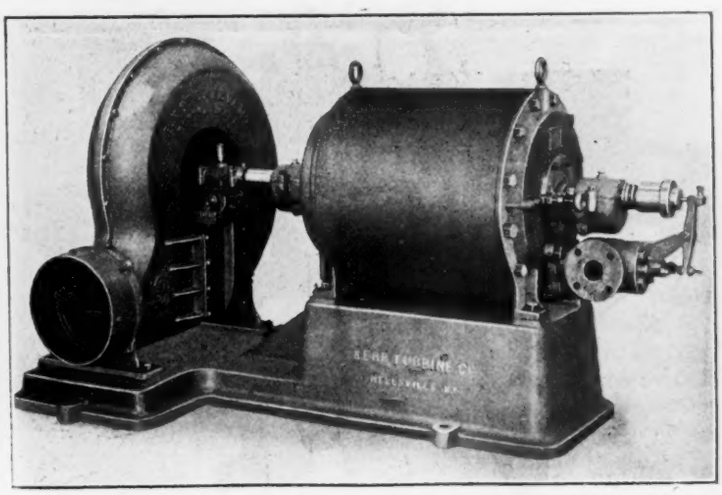


FIG. 1—KERR STEAM TURBINE, DIRECT-CONNECTED TO A BLOWER FOR CUPOLA SERVICE

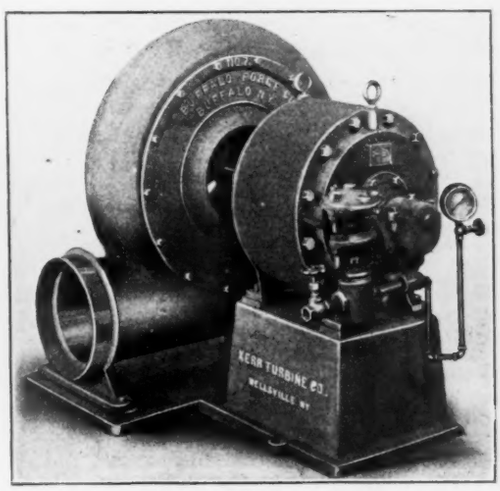


FIG. 2—KERR TURBINE, DIRECT-CONNECTED TO A VOLUME BLOWER FOR FORCED DRAFT

FIG. 1—ARCADE SQUEEZER IN RAMMING POSITION

Outside the groove the diaphragms are in contact with an accurately faced metal to metal joint. The end castings carry the weight of the turbine, and are provided with accurately faced supports, which are bolted to the bed plate. The end castings are each bored to receive the bearing cases, which center with them, and as the diaphragms are centered with each other and with the end castings, the two bearings are accurately centered and in line whenever the machine is assembled.

The rotor is made up of a steel shaft, upon which are mounted the bucket wheels and the governor. The bucket wheels are mounted on cast iron or steel rings, and these are threaded on split hubs fitted to the shaft and held in place by pin keys of ample cross-section. The governor is of the centrifugal type, and is mounted on the end of the shaft and rotates with it.

THE ARCADE SQUEEZER.

A molding machine of the squeezer type has been added to the extensive line of foundry labor-saving devices built by the Arcade Mfg. Co., Freeport, Ill. The machine was developed in the foundry operated by this concern, and has been in successful operation for some time. The machine, Figs. 1 and 2, is designed for the use of either match-plates or gated patterns, and in Fig. 2 is shown a double-face match-plate, by the use of which both cope and drag can be made in one operation. The ramming head in this illustration is tilted back, and the supports for the flask or table, as well as the adjustable guide for accurately locating the flask, are shown. The ramming of the mold is accomplished by a double-geared toggle device, patented by the Arcade Mfg. Co. The first part of the travel of the operating lever throws down the head rapidly, but as it descends and the gears of the toggle approach a vertical position, the descent is less rapid, while the leverage is proportionately increased, thereby increasing the pressure brought to bear upon the mold. By adjusting the height of the ramming board, it is possible to ram the mold to any desired density. The cope board is attached to the ramming head by either screws or bolts.

When making a mold, a snap flask is placed on the machine with the pattern plate between the cope and drag. Sand is riddled into the top of the flask, the head is swung forward, and the mold is rammed by the downward stroke of the lever, as shown in Fig. 1. The swinging head, which is counterbalanced to permit of its easy movement back and forth, is then swung back, the flask rolled over and the ramming of the cope is merely a repetition of the drag molding operation.

The vibrating of the pattern is accomplished by a 1½-inch vibrator placed at the front of the machine, operated by a knee lever, clearly shown in Fig. 2. The machine is mounted on three wheels, thereby always insuring a firm support, regardless of the condition of the foundry floor. To facilitate the work of the molder, the machine has been provided with all conveniences, including a support for the riddle at the right and a table at

FIG. 2—MOLDING MACHINE WITH RAMMING HEAD TILTED BACK

the loft for bottom boards, as well as the flask in use. The shelf above the machine is of adequate size to care for all necessary tools, parting sand, and patterns.

THE MONARCH PORTABLE CORE OVEN.

The core oven shown in the accompanying illustrations, manufactured by the Monarch Engineering & Mfg. Co., Baltimore, is of the portable type and can be fired with either gas or oil. It is equipped with six rectangular trays, thereby permitting the use of the entire area of each shelf for baking the cores. In Fig. 1 the trays have been drawn out, and it will be noted that the oven is practically closed by the sheet steel shutters which form the backs of the trays. These shutters are provided to prevent the escape of the heat when a tray is drawn out for receiving or discharging cores. In Fig. 2, one shelf loaded with cores is shown drawn out and is supported at its forward end by one of the hooks attached to the bar of the overhead trolley, which is moved back and forth on the rail as the trays are moved in or out. The portable oven illustrated is 2 x 3 x 6 feet, although ovens of this type are made in different sizes to meet varying foundry requirements.

RECORD OUTPUT OF AUTOMOBILE CYLINDERS.

On Saturday, November 6, the Ferro Machine & Foundry Co., Cleveland, manufacturer of marine engines, cylinders and gray iron castings, tendered a banquet to the members of its foundry organization, in view of the large number of automobile cylinder castings produced that day, which established a new high record. A maximum daily tonnage was fixed several months ago, and this was reached November 6. The output mounted to 1,100 cylinders, which is, undoubtedly, the largest number ever turned out by any foundry during this period on this type of castings. The output of cylinders during the 1910 season by this concern will be greater than at any time in the past, and the capacity will be materially increased by the erection of a machine shop and core room, while other departments are also being enlarged.

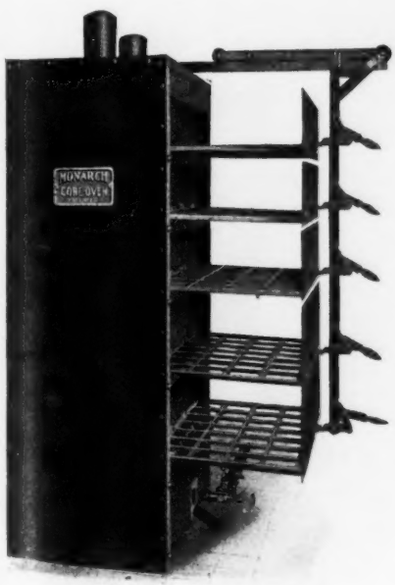


FIG. 1—MONARCH CORE OVEN WITH TRAYS DRAWN OUT

THE FERRACUTE SPRUE CUTTING PRESS.

The press shown in the accompanying illustration, built by the Ferracute Machine Co., Bridgeton, N. J., has been designed for cutting sprues and gates from brass and other soft metal castings. The operator has the use of both hands when handling the work, the press making a stroke only when the treadle is depressed, the automatic clutch causing it to stop as soon as the stroke has been made. The frame is designed so as to permit the cutting of sprues from long as well as the short castings, and the cutters are made of tool steel of ordinary commercial shape and size. The lower cutter is adjusted by a screw and may, therefore, be set at a height that will cause the cutters to barely touch at the bottom of the stroke.

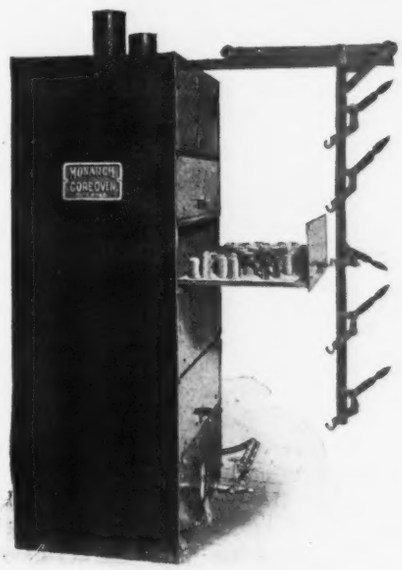
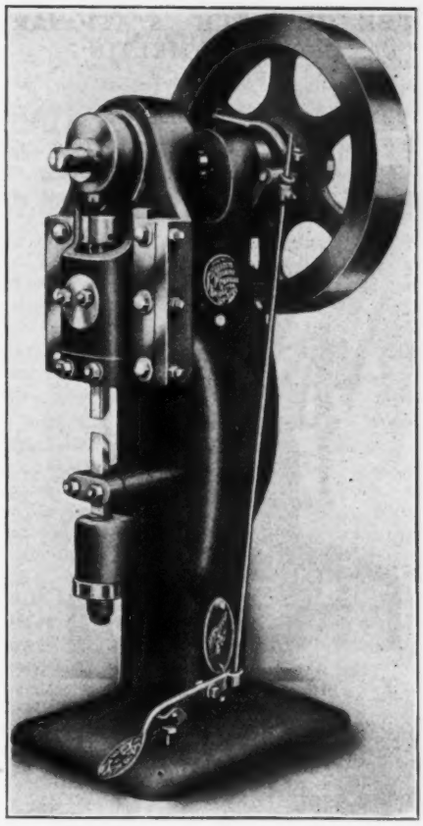


FIG. 2—CORE OVEN WITH ONLY ONE TRAY DRAWN OUT



THE FERRACUTE SPRUE CUTTING PRESS

This press is the third of a series of six sizes built by this concern, two being smaller and three of larger sizes. The stroke is 1½ inches, but this can be increased or decreased if desired. The weight of the press illustrated is 3,300 pounds; the ram has an adjustment downward of 3 inches; the distance from the cutters back to the throat of the press frame is 7 inches; the fly-wheel is 35 inches in diameter, 6 inches face and weighs 750 pounds. Round brass up to 1½ inches in diameter can be cut on this machine.

The Manufacturers' Supply House of Erie, located at Erie, Pa., carries a full line of foundry facings, supplies and equipment. The supplies manufactured by the J. W. Paxson Co., Philadelphia, are handled by this concern, which, in addition operates its own molding sand pits at Conneaut, O., Springfield and Fairview, Pa., as well as a large pit in the western part of New York, from which is shipped Empire sand for brass and aluminum work. In addition, this concern deals in Connellsville foundry, furnace, stock and crushed coke, as well as Pittsburg, Youghiogheny and Bessemer coal.

THE MONARCH STATIONARY CRUCIBLE MELTING FURNACE.

To meet the demands for a melting furnace having a removable crucible, the Monarch Engineering & Mfg. Co., Baltimore, has designed the

FIG. 1—STATIONARY MELTING FURNACE WITH CRANE IN POSITION TO LIFT THE CRUCIBLE

type shown in Figs. 1 and 2, which is equipped with a crane for setting the pot into the furnace and for removing the same after the metal has been melted. This furnace is especially adapted for use in shops where the pot is lifted out and is used for pouring the metal. In Fig. 1, the furnace is shown with the crane in position for lifting the crucible into the furnace, and in Fig. 2, the

FIG. 2—CRUCIBLE RAISED AND IN POSITION TO BE LOWERED INTO POT

pot has been raised, the crane swung over, in position to deposit the crucible with its charge into the furnace. The crucible is lifted by a chain attached to the tongs, the chain being wound up on a small drum on the spindle of the hand wheel. The furnace is provided with a swinging cover, which is moved aside by depressing the lever shown in an upright position in Fig. 1. The opening in the furnace cover permits the products of combustion to escape, and in addition can be used for introducing metal into the crucible, or for inspecting the condition of the metal as it melts. These furnaces can be arranged for installation in pits or above the floor level as desired, and are furnished with or without the lifting crane. Gas or oil can be used for fuel.

PORTABLE POWER RAMMING MOLDING MACHINE.

A portable, power-ramming molding machine operated by compressed air, manufactured by the J. F. Webb Mfg. Co., Davenport, Iowa, is shown in Figs. 1 and 2. The machine with the ramming head swung back in position for placing the flask on the table is shown in Fig. 1, and in Fig. 2 the head has been swung forward in ramming position. The cylinder is adjustable vertically by means of the nuts on the side rods, which permit the ramming of the sand to any desired density. A pop valve above the cylinder controls the air pressure, which makes it impossible to ram the sand too hard, and insures uniform molds. To facilitate the movement of the swinging head, springs are provided, and in addition it is well balanced, so that it can be moved backward and forward with little effort. Air is let into the cylinders by the operation of a three-way valve at the right of the machine. The valve is provided with a stop, which can be fixed at any desired pressure, so that after being set, no further attention need be given to the quantity of air to be let into the cylinder for ramming the mold. The machine is adapted for ramming either cope or drag, or the entire mold in one operation. When using split patterns mounted on a plate, the latter is interposed between the cope and drag flasks, and after filling the drag with sand, the bottom board is adjusted, the flask is rolled over, the cope is filled with sand, the cope board adjusted, and the entire mold is rammed in one operation. Flasks, 14 x 20 inches and 8 inches deep, can be rammed with an air pressure of 40 pounds. The machine is provided with a knee vibrator and is built in two sizes, 10 x 30 inches, and 12 x 36 inches.

TRADE NOTES.

Charles D. Hadfield, for the past ten years superintendent of the John Meighan foundry facing plant, Pittsburg,

FIG. 1—POWER-RAMMING MOLDING MACHINE, WITH HEAD TILTED BACK

is now connected with the Federal Foundry Supply Co., Cleveland. Mr. Hadfield has had a wide experience in the grinding of facings for foundry use, and it is the intention of the Federal Foundry Supply Co. to extend its

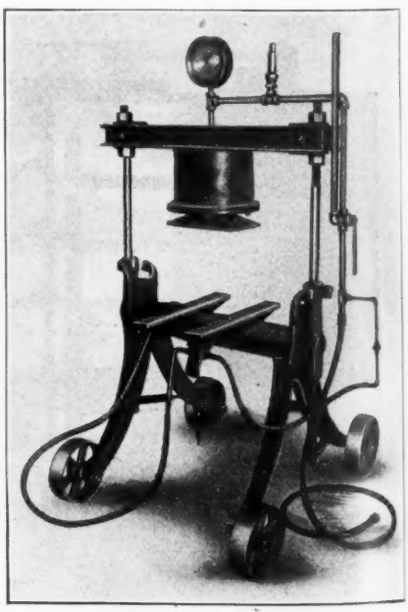


FIG. 2—MOLDING MACHINE WITH HEAD TILTED FORWARD IN RAMMING POSITION

line of facings by the addition of a special roll blacking, dry sand blacking and a core wash.

Alfred Fisher, Chicago, will furnish the additional brass melting equipment, which will be installed in the new foundry that will be erected by the Lumen Bearing Co., Buffalo. This extension will be 60 x 90 feet.

Henry E. Pridmore, Chicago, has recently made sales of power-ramming, rock-over drop molding machines, described in the May, 1909, issue of THE FOUNDRY, to the General Electric Co., for installation at West Lynn and Pittsfield, Mass., and Schenectady, N. Y. Several large machines have also been purchased by Wm. Sellers & Co., Inc., and the Baldwin Locomotive Works, Philadelphia.

The Whiting Foundry Equipment Co., Harvey, Ill., has received an order for nine 10-ton electric traveling cranes, each bridge carrying two 5-ton trolleys, from the Illinois Steel Co., Chicago, for installation in the North Works of this concern.

John A. Roebling's Sons Co., Trenton, N. J., has placed an order with Tate, Jones & Co., Inc., Pittsburg, for the entire oil burning equipment for its battery of six 30-ton open hearth furnaces. The oil burning equipment is also being furnished for one open-hearth furnace for the Lobdell Car Wheel Works, Wilmington, Del., and for one furnace of the Canada Iron Corporation, Londonderry, N. S., Can.

The Buffalo Foundry Supply Co., Buffalo, has been incorporated with $20,000 capital, to take over the business of the unincorporated company of the same name. This concern will continue the manufacture of foundry facings, Columbian core wash and other foundry supplies. The plant has a capacity of six carloads of facings daily. The officers are as follows: J. A. Heinsheimer, president; Marc Heinsheimer, secretary and treasurer, and A. E. Heinsheimer, general manager.

The headquarters of Takata & Co. have been removed to suite 350 to 387, Hudson Terminal building, 50 Church street, New York City.

Walter-Wallingford & Co., Cincinnati, have been appointed selling agents of the pig iron produced by the Southern Iron & Steel Co., Birmingham, in Chicago, Cleveland, Pittsburg, Cincinnati, Louisville and all intermediate territory. A Chicago office has been established.

The Arthur D. Little, Inc., Laboratory of Engineering Chemistry, Boston, has issued a copyright brochure entitled "The Purchase of Coal", which treats of the method of buying coal on the basis of its value in British thermal units.

The American Blower Co., Detroit, is sending to the trade a circular containing a comparison of "Sirocco" with steel plate fans. Three typical examples, illustrating points of advantages of the "Sirocco" fan, are given, which may be summarized as follows: Increased efficiency, resulting in a saving of horsepower for the same capacity; increase in capacity of fan for the same power; smaller space occupied for a given capacity; slower speed, etc.

A customer of the Pennsylvania Forge Co., Philadelphia, was using steel dies for hot forging and drawing work, which were giving an average service of two days, breaking from crystallization and other defects in the steel. It was decided to try vanadium steel in the hope that the remarkable properties of vanadium in retarding or eliminating crystallization would give the dies a longer period of usefulness. Vanadium steel was purchased from the Bethlehem Steel Co., and the dies made by the Pennsylvania Forge Co. from this material used in the same manner, by the same man, on the same machine, and for the same service as those previously referred to, have been used for more than four months, and are still in serviceable condition.

The J. D. Smith Foundry Supply Co., Cleveland, was awarded the equipment contract for the new foundry that is being erected by the Currie Windmill & Pump Co., Topeka, Kansas.

The Federal Foundry Supply Co., Cleveland, has recently placed on the market three new blackings, known as the Federal special roll blacking, Federal dry sand blacking and Federal core wash. In the manufacture of these blackings only the highest grade of 72-hour coke is used, and as they are ground very fine and carefully bolted, these blackings are instantly soluble.

TRADE PUBLICATIONS.

FLEXIBLE TRANSMISSION.—The Coates unit link flexible shafting, manufactured by the Coates Clipper Mfg. Co., Worcester, Mass., is described in bulletin No. 22, containing 66 pages, issued by this concern. The wide application of this flexible transmission is shown by numerous illustrations. It is used for buffing, drilling, polishing, grinding metals, and glass, clipping, painting, aluminum roughing, etc. This flexible shafting is well adapted for grinding castings, and the electric stove polishing outfit is described in detail. An electric hammer operated by a flexible shaft is one of the latest developments of this transmission, and it is claimed that it strikes a blow equal to that of a pneumatic hammer.

MOLDING MACHINES.—The Arcade Mfg. Co., Freeport, Ill., in catalog No. 23, describes the modern molding machine, which is adapted for the production of molds usually made in snap flasks by bench molders. Match plates are used, both cope and drag being made in one operation. The Norcross jolting machine, made by this concern, is also illustrated and many views of castings made on the Modern machine, together with foundry floors representing a day's work are included. The catalog is handsomely illustrated and is printed in two colors.

ENGINES.—The Wisconsin Engine Co., Corliss, Wis., is sending to the trade a loose-leaf binder containing the first of a series of bulletins, which will be issued from time to time, describing the various types of engines and machinery built by this concern. The first bulletin contains considerable engineering data and many illustrations of heavy duty Corliss engines.

OVERHEAD TRAMWAYS.—The Cameron Engineering Co., 154 Berriman street, New York City, is sending to the trade an eight-page circular describing its line of overhead tramways, trolleys, switches, cranes, scales and other overhead handling devices. A pulley block crane is also shown, mounted on four truck wheels, adapted both for hoisting and conveying.

PAINTS.—The Semet-Solvay Company, Syracuse, N. Y., is sending to the trade a 30-page circular, envelope size, which describes protective paints for iron and steel. This paint is designed for use upon corrugated iron, structural steel, viaducts, gas holders, coal-handling plants, metal roofs, tanks, blast furnaces, chemical plants, etc.

CRANES.—"Railroad, Shop and Yard Cranes," is the title of a 24-page catalog recently issued by the Whiting Foundry Equipment Co., Harvey, Ill. It gives a general outline of the purpose for which cranes are used in railroad yards and shops, and the illustrations are reproduced from photographs of installations covering the entire range of railroad crane service, from the handling of complete locomotives and parts to the transfer of freight, etc. This concern manufactures complete equipment for foundry plants for the production of car wheels, gray iron, steel and malleable castings.

GENERAL INDUSTRIAL NOTES

The Benton Harbor Malleable Foundry Co., Benton Harbor, Mich., has increased its capital from $40,000 to $70,000. This concern has recently completed an addition to its foundry, 65 x 85 feet, core room, 45 x 65 feet, annealing room, 25 x 100 feet.

The United Boiler, Heater & Foundry Co., Hammond, Ind., has been incorporated with $20,000 capital, to engage in the manufacture of gray iron castings. Otto Knoezer, C. H. Cass, Walter Williams, J. S. Blackman and W. S. McEwen are directors.

The Frankfort Brass Mfg. Co., Frankfort, Ind., has been incorporated with $25,000 capital. The directors are J. A. Johnson, G. A. Burgess, R. R. Hawxhurst, G. L. Wire and F. L. Tuttle.

The plant of the Dutcher Steel Casting Co., Milwaukee, has been purchased by the Prime Steel Co., of that city. The Dutcher company manufactures acid open-hearth steel castings, whereas the Prime Steel Co. produces castings by the crucible process. This foundry will hereafter be known as the Dutcher plant of the Prime Steel Co.

The Latrobe Foundry Co. and the Baltimore Foundry Co., Baltimore, have been consoli-

dated under the firm name of the Baltimore Foundry Co.

The foundry of the Oregon State Penitentiary, Salem, Ore., destroyed by fire last summer, has been rebuilt. The plant will be operated by Lavenburg, Going & Co., which will employ convict labor in the manufacture of stoves and ranges.

The Bradford Foundry Co., Ltd., Bradford, Pa., manufacturer of brass, bronze and aluminum castings, has succeeded to the foundry business of the G. W. Fleming Co.

The Weber Mfg. Co., Jamestown, N. Y., has purchased the Eberman-Bailey Brass Foundry Co., of that city, and will operate the same in the future in connection with its own plant.

The Cyclops Foundry Co., 2007 Union Bank bldg., Pittsburg, recently incorporated with $100,000 capital, has purchased the plant of the Monongahela Casting Co., Monongahela, Pa., together with five acres of ground. The foundry is located on the Monongahela division of the Pennsylvania railroad. The main building contains 35,350 square feet of floor space, including boiler and engine rooms, machine shop, core department, molding floor, etc., the pattern shop, storage room, drafting department and office being located on the second floor. The plant is electrically lighted and is heated by a hot air blast system throughout. The foundry equipment includes a cupola, overhead cranes, and eight molding machines, four of which are capable of producing machine molded castings up to 500 pounds in weight. In addition to a general line of jobbing work, this concern will make a specialty of machine-molded castings.

The Valley Field Iron Works, Valley Field, P. Q., Canada, has added a department for the manufacture of aluminum castings. It is in charge of A. Moore.

The Weber Mfg. Co., Jamestown, N. Y., manufacturer of furniture trimmings, brass, bronze and aluminum castings, has been succeeded by the Weber-Knapp Co., which will continue the manufacture of the same line of goods.

The Le Grand Bronze Co. has been incorporated at Plainfield, N. J., and will engage in the production of "Le Grand" bronzes in ingots, billets and castings. The office and works are located at 417-419 Berckman street.

McCambridge & Co., Ltd., and the Wm. S. Cooper Brass Works, Philadelphia, manufacturers of plumbers' brass goods, have consolidated under the name of the McCambridge & Cooper Co. The plants of the Wm. S. Cooper Brass Works will be abandoned, and all of the manufacturing will be confined to the McCambridge works.

The Peerless Ice Machine Co., Cleveland, recently organized, has established a plant at Collinwood, O., for the manufacture of ice making machinery. It includes a foundry, 40 x 60 feet; machine shop, 60 x 120 feet; pattern shop, 20 x 40 feet and blacksmith shop, 30 x 36 feet. The company is capitalized at $100,000. J. A. Kling is president and J. F. Miller is secretary and treasurer.

The Cream City Foundry Co., Milwaukee, has been incorporated with $20,000 capital, by Joseph Foertsch and others.

The Lawrence Iron & Steel Foundry Co., Pittsburg, formerly the Yagle Foundry & Machine Co., has installed a 15-ton open-hearth furnace.

The Michigan Malleable Iron Co., Detroit, whose annealing department and machine shop were recently destroyed by fire, announced that it is again operating its plant at full capacity.

The Youngstown Foundry & Machine Co., Youngstown, O., has discontinued the manufacture of steel castings at its East Boardman street works, and has installed one 25-ton and one 15-ton air furnace for the manufacture of sand, chilled and semi-steel rolls. Six roll lathes will be added and the new roll plant will be placed in operation about Jan. 1.

The Aluminum Co. of America, Pittsburg, has filed notice of an increase in its capital stock to $20,000,000. This concern is now capitalized at $3,800,000, of which $600,000 is preferred. It is stated that the new stock will be common, and the additional capital represents improvements and additions to equipment that have been made from time to time by this concern.

The Londonderry Iron & Mining Co., Ltd., Londonderry, N. S., has added a steel casting department, 100 x 85 feet, in which a 7½-ton basic open-hearth furnace has been installed. An annealing furnace has also been added, of sufficient capacity to handle sections up to 30 feet in length.

The Gammon Meter Co., Newark, N. J., has equipped a brass foundry for the production of castings required in the construction of the water meters which it manufactures.

New Construction.

The Indianapolis Brass Co., Indianapolis, succeeds the Indianapolis Aluminum & Brass Co., which was organized in 1906, and the capital stock has been increased from $10,000 to $25,000. A new factory site, 222 x 310 feet, has just been purchased for $15,000 and a new foundry, 40 x 100 feet, is being erected, as well as a machine shop, 25 x 50 feet. A new office building is also being built at 1012 to 1022 East Michigan street.

A non-ferrous metal reducing plant is being built at Lorain, O., by S. W. Vaughan. Two furnaces will be installed in a building, 40 x 60 feet.

The Seaboard Steel Casting Co., Chester, Pa., is building additions to its foundry and machine shop, which will increase the capacity of the plant about 40 per cent.

The Atha Steel Casting Co., Newark, N. J., will erect an addition to its plant, 23 x 190 feet. The building will be of concrete construction, and will house the cleaning and chipping department.

The Hollenbeck Mfg. Co., Holdredge, Neb., is contemplating the erection of a new foundry.

The Denver City Tramway Co., Denver, Colo., contemplates the erection of a foundry.

The Riverview Bronze & Mfg. Co., Buffalo, recently organized, will erect a new plant at 17-30 Gull street, for the manufacture of manganese and phosphor bronze, brass and aluminum castings for automobiles and motor boats. Two buildings will be erected, 50 x 60 feet and 50 x 96 feet. The company is capitalized at $50,000 and R. P. Deardorff is secretary and treasurer.

The Emerson Mfg. Co., Rockford, Ill., manufacturers of agricultural implements, is building an addition to its plant, 80 x 740 feet, one-half of which will be three stories and the other half one story high.

The Fillmore Avenue Foundry & Iron Works, Buffalo, will make extensive additions to its plant, which will enable it to largely increase its output, and provide additional capacity for the large tonnage recently closed.

Clement Bush, Quincy, Ill., whose plant was recently destroyed by fire, is rebuilding the same, the new structure being of brick and concrete construction, 70 x 100 feet.

Work has been commenced on an addition to the foundry of Louis Sacks, Newark, N. J. The plans include a three-story building, 37 x 110 feet, and a one-story carpenter shop, 20 x 80 feet.

The Johnston & Jennings Co., Cleveland, which operates foundries for the manufacture of sash weights in Cleveland and Chicago, will erect a new sash weight plant at 1720 Elston avenue, Chicago, at a cost of approximately $30,000. While sash weights made in the Cleveland plant are cast in permanent molds, this product will be hand-molded in the Chicago foundry.

The Detroit Valve & Fittings Co., Detroit, is preparing plans for the erection of a plant at Wyandotte, Mich., for the manufacture of brass, malleable and cast iron fittings.

The Leader Foundry & Machine Co., Quincy, Ill., which has recently absorbed the firm of the Sharpe & Becker Machine Co., has commenced the erection of a new plant 96 x 100 feet.

Lynchburg Foundry Co. interests, Lynchburg, Va., are preparing plans for a cast iron pipe foundry to be erected on a large site acquired some time ago at Norfolk, Va. The plant will have an output of 100 tons per day, but provisions will be made to increase this capacity in the future. The Norfolk works will be operated as the McWane Tidewater Pipe Works Co., a corporation which will be controlled by the Lynchburg Foundry Co.

The Burlington Brass Works, Burlington, Wis., manufacturers of plumbers' brass goods, will erect an addition to their plant, 75 x 150 feet.

A new brass foundry, 162 x 169 feet, will be built by the Hancock Mfg. Co., Charlotte, Mich.

A new brass foundry is being erected by Henry W. Wright, Springfield, Vt.

The Kelly & Jones Co., Pittsburg, will erect an addition to its plant at Greensburg, Pa., consisting of a new foundry, 60 x 395 feet.

The Vulcan Iron Works, New Britain, Conn., manufacturers of malleable iron castings, will build a new foundry, 110 x 205 feet, of brick and steel construction. An air furnace will be added to the melting equipment, and the annealing capacity will also probably be increased.

The Smith & Watson Iron Works, Portland, Ore., is erecting a foundry, 80 x 200 feet, which will be equipped with sufficient crane capacity for handling castings up to 20 tons in weight. In addition a machine shop, 110 x 200 feet, is being built.

The D. J. Murray Mfg. Co., Wausau, Wis., is contemplating the erection of a new foundry, 80 x 100 feet.

The American Steel Foundries Co. will erect an addition to its plant at Alliance, O., 55 x 180 feet.

E. E. Brown & Co., Philadelphia, will erect a new foundry for the manufacture of sash weights. The building will be 80 x 112 feet, and of steel and reinforced concrete construction.

The United States Malleable Iron Co., Toledo, O., is enlarging its plant by the erection of four buildings, which will provide an increase in producing capacity of about 70 per cent.

The Standard Brass Foundry Co., 6522 to 6532 Central avenue, Cleveland, has purchased a site, 50 x 200 feet, adjoining its present property. Another foundry building will be erected, thereby increasing the capacity of the aluminum department of this concern practically three-fold.

The foundry of the Harrigan Safe Co., Kansas City, was destroyed by fire November 11, entailing a loss of about $7,000. The plant will be immediately rebuilt.